U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

SCREW-THREAD STANDARDS FOR FEDERAL SERVICES 1944

Superseding Handbook H28 (1942)

HANDBOOK H28 (1944)

UNITED STATES DEPARTMENT OF COMMERCE • JESSE H. JONES, *Secretary*
NATIONAL BUREAU OF STANDARDS • LYMAN J. BRIGGS, *Director*

NATIONAL BUREAU OF STANDARDS HANDBOOK H28 (1944)

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Foreword

The Interdepartmental Screw Thread Committee has been established by the Departments of War, Navy, and Commerce to promote uniformity in screw-thread standards in the Departments concerned.

The Committee is charged: (1) With the development of standards for screw threads; (2) the standardization of gages, dies, and taps; and (3) the standardization of dimensions of nuts, bolt heads, wrenches and other items associated with the manufacture and use of interchangeable threaded parts. Standards developed by the Committee, when approved by the Departments concerned, are to be published together with a joint order making their use mandatory in the Departments of War, Navy, and Commerce, except where a need for deviations therefrom is shown. Standards thus established are subject to such extension and revision as the Committee may find desirable.

The basis for this Handbook is the 1933 report, and preceding reports, of the National Screw Thread Commission, and Handbooks H25 dated 1939, and H28 dated 1942, which superseded those reports and which this Handbook supersedes, together with pertinent standards approved and promulgated by the American Standards Association.

LYMAN J. BRIGGS, *Chairman.*

CONTENTS

APPROVAL BY THE SECRETARIES OF WAR, NAVY, AND COMMERCE

The accompanying Handbook H28 (1944) on screw-thread standards for Federal services, submitted by the Interdepartmental Screw Thread Committee, is hereby approved, and the use of these standards by the Departments of War, Navy, and Commerce, except where a need for deviation therefrom is shown, is hereby ordered.

Henry L. Stimson
Secretary of War

James Forrestal
Secretary of the Navy

Jesse H. Jones
Secretary of Commerce

1944 HANDBOOK OF SCREW THREAD STANDARDS FOR FEDERAL SERVICES

As Approved 1944

SECTION I. INTRODUCTION

1. PURPOSE OF FEDERAL STANDARDS FOR THREADED PRODUCTS

The purpose of this handbook is to present complete dimensional data upon which specifications may be based for threaded products for Government requirements. So far as practicable, these data are intended to conform to generally accepted commercial practice, although certain special requirements of the Government necessitate the inclusion of some standards not generally applicable outside of the Government services. References are cited throughout the text to the standards promulgated by the American Standards Association, and to such other published standards as are in agreement with the specifications herein.

There are included in the body of the handbook specifications for threaded products and gages, embodying sufficient information to permit the writing of definite and complete specifications for the purchase of screw-thread products. In the appendixes there is arranged supplementary information of both a general and a technical nature, including such specifications as are not intended to be mandatory.

The specifications in the handbook have been arranged, as far as possible, by products. For example, one section deals with threads for bolts and nuts, etc., another with hose-coupling threads, another with pipe threads, another with wrench-head bolts and nuts, etc.

2. PERSONNEL OF THE COMMITTEE

The personnel of the Interdepartmental Screw Thread Committee is as follows:

Representing the War Department:

Col. Harry B. Hambleton, Office of Chief of Ordnance, War Department, Room 2C-439 Pentagon Building, Washington, D. C.

Lt. Col. A. F. Wentzel, Air Corps, Wright Field, Dayton, Ohio.

Representing the Navy Department:

Comdr. James E. Cohn, Naval Gun Factory, U. S. Navy Yard, Washington, D. C.

Capt. Wm. C. Latrobe, Bureau of Ships, U. S. Navy Department, Washington, D. C.

Representing the Department of Commerce:

Dr. Lyman J. Briggs, Chairman, Director, National Bureau of Standards, Washington, D. C.

Mr. Henry W. Bearce, Secretary, Chief, Division of Weights and Measures, National Bureau of Standards, Washington, D. C.

Liaison Representatives of the American Standards Association:

Mr. Earle Buckingham, Professor, Massachusetts Institute of Technology, Cambridge, Mass. (Member of the ASME and SAE).

Mr. J. H. Edmonds, General Manager, Lebanon Plant, Bethlehem Steel Co., Lebanon, Pa. (Member of ASA Committee B18).

Mr. A. M. Houser, Engineer of Standardization, Crane Co., 836 South Michigan Avenue, Chicago, Ill. (Member of the ASME).

Mr. Chas. C. Winter, 25 East Street, Wrentham, Mass. (Member of ASA Committees B2 and B4).

SECTION II. TERMINOLOGY

In this handbook there are utilized, as far as possible, nontechnical words and terms which best convey alike to the producer and user of screw threads the information presented.

1. DEFINITIONS

The following definitions are given of the more important terms used in the handbook. Definitions of terms which are obviously elementary in character are intentionally omitted.

(*a*) TERMS RELATING TO SCREW THREADS.—1. *Screw thread.*—A ridge of uniform section in the form of a helix on the external or internal surface of a cylinder, or in the form of a conical spiral on the external or internal surface of a cone.

2. *External and internal threads.*[1]—An external thread is a thread on the outside of a member. Example: A threaded plug.

An internal thread is a thread on the inside of a member. Example: A threaded hole.

3. *Major diameter.*—The largest diameter of the thread of the screw or nut. The term "major diameter" replaces the term "outside diameter" as applied to the thread of a screw and also the term "full diameter" as applied to the thread of a nut.

4. *Minor diameter.*—The smallest diameter of the thread of the screw or nut. The term "minor diameter" replaces the term "core diameter" as applied to the thread of a screw and also the term "inside diameter" as applied to the thread of a nut.

5. *Pitch diameter.*—On a straight screw thread, the diameter of an imaginary cylinder, the surface of which would pass through the threads at such points as to make equal the width of the threads and the width of the spaces cut by the surface of the cylinder. On a taper screw thread, the diameter, at a given distance from a reference plane perpendicular to the axis of an imaginary cone, the surface of which would pass through the threads at such points as to make equal the width of the threads and the width of the spaces cut by the surface of the cone.

6. *Pitch.*—The distance from a point on a screw thread to a corresponding point on the next thread measured parallel to the axis.

$$\text{The pitch in inches} = \frac{1}{\text{Number of threads per inch}}.$$

7. *Lead.*—The distance a screw thread advances axially in one turn. On a single-thread screw the lead and pitch are identical; on a double-thread screw the lead is twice the pitch; on a triple-thread screw the lead is three times the pitch, etc.

[1]These terms are here defined because of possible confusion arising from the fact that an "internal member" has an "external thread," and vice versa. For the sake of brevity an external thread is hereinafter referred to as a "screw," and an internal thread as a "nut."

8. *Angle of thread.*—The angle included between the sides of the thread measured in an axial plane.

9. *Half angle of thread.*—The angle included between a side of the thread and the normal to the axis, measured in an axial plane.

10. *Helix angle.*—The angle made by the helix, or conical spiral, of the thread at the pitch diameter with a plane perpendicular to the axis.

11. *Crest.*—The surface of the thread corresponding to the major diameter of the screw and the minor diameter of the nut.

12. *Root.*—The surface of the thread corresponding to the minor diameter of the screw and the major diameter of the nut.

13. *Side or flank.*—The surface of the thread which connects the crest with the root.

14. *Axis of a screw.*—The longitudinal central line through the screw.

15. *Base of thread.*—The bottom section of the thread; the greatest section between the two adjacent roots.

16. *Depth of thread.*—The distance between the crest and the base of the thread measured normal to the axis.

17. *Number of threads.*—Number of threads in 1 inch of length.

18. *Length of engagement.*—The length of contact between two mated parts, measured axially.

19. *Depth of engagement.*—The depth of thread contact of two mated parts, measured radially.

20. *Pitch line.*—An element of the imaginary cylinder or cone specified in definition 5.

21. *Thickness of thread.*—The distance between the adjacent sides of the thread measured along or parallel to the pitch line.

22. *Mean area.*—The term "mean area of a screw," when used in specifications and for other purposes, designates the cross-sectional area computed from the mean of the basic pitch and minor diameters.

(*b*) Terms Relating to Classification and Tolerances.—1. *Allowance.*—An intentional difference in the dimensions of mating

parts. It is the minimum clearance or the maximum interference which is intended between mating parts. It represents the condition of the tightest permissible fit, or the largest internal member mated with the smallest external member. Examples:

One half inch, class 1 fit, American National coarse thread series:

Minimum pitch diameter of nut	0.4500
Maximum pitch diameter of screw	.4478
Allowance (positive)	0.0022

One half inch, class 4 fit, American National coarse thread series:

Minimum pitch diameter of nut	.4500
Maximum pitch diameter of screw	.4504
Allowance (negative)	0.0004

2. *Tolerance.*—The amount of variation permitted in the size of a part. Example:

One half inch screw, class 1 fit, American National coarse thread series:

Maximum pitch diameter	0.4478
Minimum pitch diameter	.4404
Tolerance	0.0074

3. *Basic size.*—The theoretical or nominal standard size from which all variations are made.

4. *Crest clearance.*—Defined on a screw form as the space between the crest of a thread and the root of its mating thread.

5. *Finish.*—The character of the surface on a screw thread or other product.

6. *Fit.*—The relation between two mating parts with reference to the conditions of assembly; for example: Wrench fit; close fit; medium fit; free fit; loose fit. The quality of fit is dependent upon both the relative size and the quality of finish of the mating parts.

7. *Neutral zone.*—A positive allowance. (See "Allowance.")

8. *Limits.*—The extreme permissible dimensions of a part. Example:

One half inch screw, class 1 fit, American National coarse thread series:

Maximum pitch diameter	0.4478	These are the limits.
Minimum pitch diameter	.4404	

(c) Terms relating to Bolt Heads and Nuts.—The following definitions are applicable to certain terms as they are used in sections XI to XIV:

1. *Unfinished.*—Unfinished bolt heads or nuts are not machined or treated on any surface except in the threads.

2. *Semifinished.*—Semifinished bolt heads or nuts are machined or otherwise formed or treated on the bearing surface so as to provide a washer face for bolt heads, and for nuts either a washer face or a circular bearing surface formed by chamfering the edges.

3. *Finished.*—Finished bolt heads and nuts are the same as semifinished except that the surfaces other than the bearing surface have been so treated as to provide a special appearance. The finish desired on all nonbearing surfaces of finished bolt heads and nuts should be specified by the purchaser.

4. *Washer face.*—The washer face is a circular boss turned or otherwise produced on the bearing surface of a bolt head or nut to relieve the corners. A circular bearing surface can also be produced by chamfering the corners of the nut.

5. *Height of head.*—The height of head is the over-all distance from the top to the bearing surface, and includes the thickness of the washer face where such is provided.

6. *Thickness of nut.*—The thickness of the nut is the over-all distance from the top to the bearing surface, and includes the thickness of the washer face where such is provided.

7. *Taper of bolt head or nut.*—The taper of a bolt head or nut is the angle between a side and the axis.

2. ILLUSTRATIONS SHOWING TERMINOLOGY

Figures 1 and 2 illustrate the use of the terms and symbols used in the handbook, as herein defined.

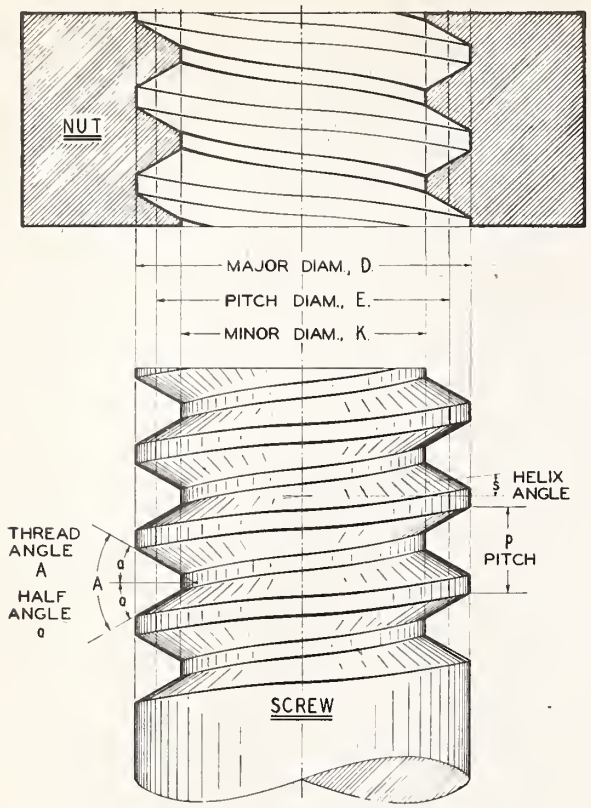

FIGURE 1.—*Screw-thread notation.*

3. SYMBOLS

Symbols for designating screw-thread standards and thread dimensions are a necessity in commercial and engineering practice. The standardization of such symbols yields the usual advantages of standardization. Those listed below have been in customary use for many years, and their general use in standards, specifications, and text-books is recommended. Additional symbols of less general application are given in those portions of the text and tables to which they pertain.

(*a*) IDENTIFICATION SYMBOLS.—These are for use on correspondence, drawings, shop and storeroom cards, specifications for parts, taps, dies, gages, etc., and on tools and gages.

The method of designating a screw thread by means of symbols is by the use of the initial letters of the thread series, preceded by the diameter in inches (or the screw number) and number of threads per inch, all in Arabic characters, and followed by the classification of fit in Arabic numerals.

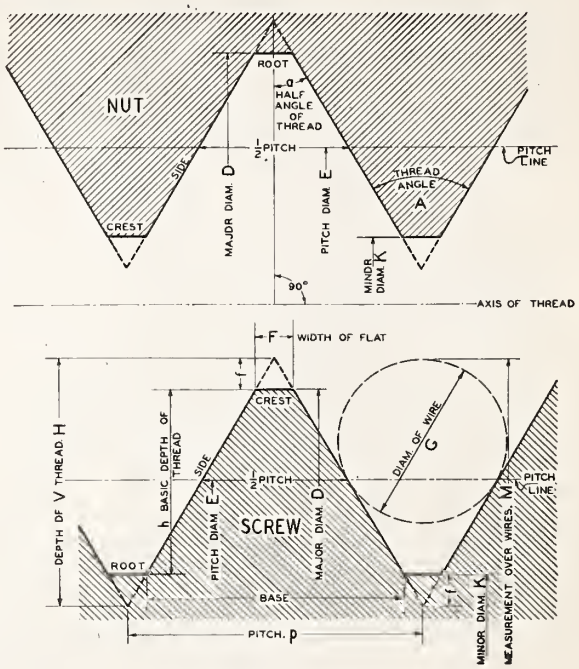

FIGURE 2.—*Screw-thread notation.*

For example, a threaded part of the American National coarse thread series, ½ inch in diameter, 13 threads per inch, class 3 fit, is designated ½"-13NC-3. *The identification symbol applicable to each thread series is stated in the section where such series is presented.* If the thread is left hand, the symbol "LH" shall follow the class of fit. No symbol is used to distinguish righthand threads. The number of threads per inch shall be indicated in all cases, irrespective of whether it is the standard number of threads for that particular size of threaded part, or special. Tools and gages for standard thread diameters and pitches shall bear standard identification symbols, and special marking of such items shall be avoided.

For screw threads of American National form but of special diameters, pitches, and lengths of engagement, the symbol "NS" shall be used. It is occasionally desirable to modify a standard thread by the inclusion

of some nonstandard feature. Thus, it might be necessary to limit the maximum major diameter of a ½"-13NC-3 screw to 0.4800 inch in order to provide clearance for a shoulder. Such a thread should be designated "nonstandard" rather than special, and this designation should be abbreviated to "nonstd." and be added, with an asterisk (*), to the thread symbol on the drawing. The nonstandard feature or dimension of the thread should be enclosed in brackets and marked with an asterisk (*). This also applies to nonstandard pitches.

(*b*) Dimensional Symbols.—For use in formulas for expressing relations of screw threads, and for use on drawings and for similar purposes, the following symbols should be used:

Major diameter.....D
Corresponding radius.....d
Pitch diameter.....E
Corresponding radius.....e
Minor diameter.....K
Corresponding radius.....k
Angle of thread.....A (alpha)
Half angle of thread.....a or α
Number of turns per inch.....N
Number of threads per inch.....n
Lead.....$L=\frac{1}{N}$
Pitch or thread interval.....$p=\frac{1}{n}$
Helix angle.....s
Tangent of helix angle.....$S=\frac{L}{3.14159 \times E}$
Thickness of thread.....t
Width of basic flat at top, crest, or root.....F
Depth of basic truncation.....f
Depth of sharp V thread.....H
Basic depth or height of truncated thread.....h
Length of engagement.....Q
Included angle of taper.....B (beta)
One half included angle of taper.....β

(*c*) Symbols for Measurements.—Other symbols, useful for expressing relations in measurements of screw threads and screw-thread gages, are:

Measurement over wires.....M
Diameter of wire.....G
Corresponding radius.....g
Error in pitch.....p'
Error in half angle of thread.....a'
Pitch diameter increment due to lead error.....E'
Pitch diameter increment due to error in half-angle.....E''

(*d*) Symbols for Pipe Threads.—Additional dimensional symbols for American National pipe threads are given in section VI and appendix 6. Identification symbols for American National straight pipe threads are given on p. 126.

SECTION III. AMERICAN NATIONAL FORM OF THREAD[2]

1. SPECIFICATIONS FOR THE AMERICAN NATIONAL FORM OF THREAD

The form of thread profile specified herein, known previously as the "United States standard or Sellers' profile," is adopted by the Committee and shall hereafter be known as the "American National form of thread."

The American National form of thread shall be used for all screw-thread work except when otherwise specified.

1. Angle of Thread.—The basic angle of thread (A) between the sides of the thread measured in an axial plane is 60°. The line bisecting this 60° angle is perpendicular to the axis of the screw thread.

2. Flat at Crest and Root.—The flat at the root and crest of the basic thread form is $\frac{1}{8} \times p$, or $0.125 \times p$.

3. Depth of Thread.—The depth of the basic thread form is

$$h = 0.649519 \times p, \text{ or } h = \frac{0.649519}{n},$$

where

p = pitch in inches
n = number of threads per inch
h = basic depth of thread

4. Clearance at Minor Diameter.—A clearance shall be provided at the minor diameter of the nut by removing from the crest of the basic thread form an amount such as to provide a depth of thread not less than 53 to 75 percent (depending on the size), and not more than 83⅓ percent of the basic thread depth.

[2] This section is in agreement with ASA B1.1-1935 "Screw Threads," published by the A.S.M.E., 29 West 39th St., New York, N. Y., (50c), with the exception of subdivision 2(b)5.

5. Clearance at Major Diameter.—A clearance shall be provided at the major diameter of the nut by making the thread form such that the width of flat shall be less than $\frac{1}{8} \times p$, but not less than $\frac{1}{24} \times p$.

There are indicated in figure 3 the relations as specified herein for the American National form of thread for the minimum nut and maximum screw, classes 2 and 3 fits. These relations are further shown in figures 7 and 9. Basic thread data for this form of thread, which are given in table 1, are based on the following specifications:

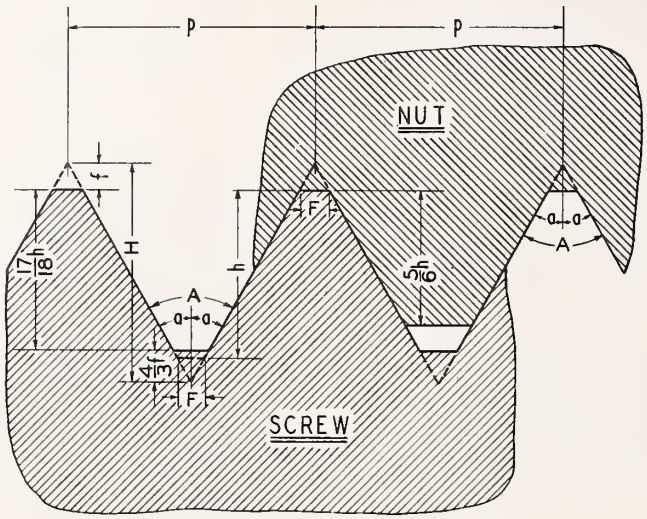

Figure 3.—*American National form of thread.*

Note.—No allowance is shown. This condition exists in classes 2 and 3 fits, where both the minimum nut and the maximum screw are basic.

NOTATION

$A = 60^\circ$
$a = 30^\circ$
n = number of threads per inch
$H = 0.866025p$ = depth of 60° sharp V thread
$h = 0.649519p$ = depth of American National form of thread
$5/6h = 0.541266p$ = maximum depth of engagement
$17/18h = 0.613435p$
$F = 0.125000p$ = width of flat at crest and root of American National form
$f = 0.108253p$
$= 1/8H$
$= 1/6h$
} = depth of truncation

TABLE 1.—*Basic thread data, American National form of thread*

Threads per inch, n	Pitch, p	Basic width of flat, $\frac{p}{8}$	Minimum width of flat at major diameter of nut, $\frac{p}{24}$	Minimum width of flat at minor diameter of nut, $\frac{p}{4}$	Depth of thread, $h = 0.649519p$	$\frac{5}{8}h = 0.541266p$	$\frac{3}{4}h = 0.487139p$	$\frac{2}{3}h = 0.433013p$	$\frac{1}{2} = 0.324760p$	$\frac{5}{12}h = 0.270633p$	$\frac{1}{3} = 0.216506p$	$\frac{1}{8} = 0.108253p$	$\frac{1}{18} = 0.036081p$	Depth of sharp-V thread, $H = 0.866025p$
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
80.....	0.012500	0.00156	0.00052	0.00312	0.00812	0.00677	0.00609	0.00541	0.00406	0.00338	0.00271	0.00135+	0.00045+	0.01083
72.....	.013889	.00174	.00058	.00347	.00902	.00752	.00677	.00601	.00451	.00376	.00301	.00150	.00050	.01203
64.....	.015625	.00195+	.00065+	.00391	.01015-	.00846	.00761	.00677	.00507	.00423	.00338	.00169	.00056	.01353
56.....	.017857	.00223	.00074	.00446	.01160	.00967	.00870	.00773	.00580	.00483	.00387	.00193	.00064	.01546
48.....	.020833	.00260	.00087	.00521	.01353	.01128	.01015-	.00902	.00677	.00564	.00451	.00226	.00075+	.01804
44.....	.022727	.00284	.00095-	.00568	.01476	.01230	.01107	.00984	.00738	.00615+	.00492	.00246	.00082	.01968
40.....	.025000	.00312	.00104	.00625	.01624	.01353	.01218	.01083	.00812	.00677	.00541	.00271	.00090	.02165+
36.....	.027778	.00347	.00116	.00694	.01804	.01504	.01353	.01203	.00902	.00752	.00601	.00301	.00100	.02406
32.....	.031250	.00391	.00130	.00781	.02030	.01691	.01522	.01353	.01015-	.00846	.00677	.00338	.00113	.02706
28.....	.035714	.00446	.00149	.00893	.02320	.01933	.01740	.01546	.01160	.00967	.00773	.00387	.00129	.03093
24.....	.041667	.00521	.00174	.01042	.02706	.02255+	.02030	.01804	.01353	.01128	.00902	.00451	.00150	.03608
20.....	.050000	.00625	.00208	.01250	.03248	.02706	.02436	.02165+	.01624	.01353	.01083	.00541	.00180	.04330
18.....	.055556	.00694	.00231	.01389	.03608	.03007	.02706	.02406	.01804	.01504	.01203	.00601	.00200	.04811
16.....	.062500	.00781	.00260	.01562	.04059	.03383	.03045-	.02706	.02030	.01691	.01353	.00677	.00226	.05413
14.....	.071429	.00893	.00298	.01786	.04639	.03866	.03480	.03093	.02320	.01933	.01546	.00773	.00258	.06186
13.....	.076923	.00962	.00321	.01923	.04996	.04164	.03747	.03331	.02498	.02082	.01665+	.00833	.00278	.06662
12.....	.083333	.01042	.00347	.02083	.05413	.04511	.04059	.03608	.02706	.02255+	.01804	.00902	.00301	.07217
11½.....	.086957	.01087	.00362	.02174	.05648	.04707	.04236	.03765+	.02824	.02353	.01883	.00941	.00314	.07531
11.....	.090909	.01136	.00379	.02273	.05905-	.04921	.04429	.03936	.02952	.02460	.01968	.00984	.00328	.07873
10.....	.100000	.01250	.00417	.02500	.06495+	.05413	.04871	.04330	.03248	.02706	.02165+	.01083	.00361	.08660
9.....	.111111	.01389	.00463	.02778	.07217	.06014	.05413	.04811	.03608	.03007	.02406	.01203	.00401	.09622
8.....	.125000	.01562	.00521	.03125	.08119	.06766	.06089	.05413	.04059	.03383	.02706	.01353	.00451	.10825+
7.....	.142857	.01786	.00595+	.03571	.09279	.07732	.06959	.06186	.04639	.03866	.03093	.01546	.00515+	.12372
6.....	.166667	.02083	.00694	.04167	.10825+	.09021	.08119	.07217	.05413	.04511	.03608	.01804	.00601	.14431
5.....	.200000	.02500	.00833	.05000	.12990	.10825+	.09743	.08660	.06495+	.05413	.04330	.02165+	.00722	.17321
4½.....	.222222	.02778	.00926	.05556	.14434	.12028	.10825+	.09623	.07217	.06014	.04811	.02406	.00802	.19245+
4.....	.250000	.03125	.01042	.06250	.16238	.13532	.12178	.10825+	.08119	.06766	.05413	.02706	.00902	.21651

2. CLASSIFICATION AND TOLERANCES

There are established herein for general use five distinct classes of screw-thread fits as specified in the following brief outline. These five classes of fit, together with the accompanying specifications, are for the purpose of insuring the interchangeable manufacture of screw-thread parts throughout the country.

It is not the intention of the Committee arbitrarily to place a general class or grade of work in a specific class of fit. Each manufacturer and user of screw threads is free to select the class of fit best adapted to his particular needs. The tolerances for five classes of fit are given in tables 3 to 9, inclusive.

Class 1 fit.... Includes screw-thread work in which the threads must assemble readily.

Class 2 fit.... Includes the major portion of interchangeable screw-thread work, finished and semi-finished bolts and nuts, machine screws, etc.

Class 3 fit.... Includes the highest grade of interchangeable screw-thread work.

Class 4 fit.... Includes screw-thread work requiring a fine snug fit, somewhat closer than class 3. In this class of fit selective assembly of parts may be necessary.

Class 5 fit.... Includes interchangeable screw thread work, consisting of steel studs set in hard materials (cast iron, steel, bronze, etc.) where a wrench-tight fit is required.

An examination of the dimensional specifications for the various classes of fit shows that a screw made to tolerances of one class of fit may be used with a nut or tapped hole made to tolerances of some other class of fit. The resulting fit may represent an intermediate class or may approximate one of the classes of fit adopted as standard. The use of different classes of tolerances on the screw and threaded hole may be justified when equipment available is such that one member can be economically produced to a higher accuracy than the other. It should be noted that in the classification of screw thread fits the class number designates the permissible limits of looseness or tightness. It has no connotations of *quality* in any other sense. Class 1 fit provides for the greatest permissible looseness between minimum screw and maximum nut; class 4 fit provides for the smallest permissible looseness. Classes 2 and 3 are between classes 1 and 4 as regards looseness. Each fit has its proper place and none should be regarded as superior or inferior provided that there is compliance with specification requirements under which it is manufactured and sold.

(a) GENERAL SPECIFICATIONS

The following general specifications apply to all classes of fit specified for applications of the American National form of thread.

1. UNIFORM MINIMUM NUT.—The pitch diameter of the minimum threaded hole or nut corresponds to the basic size.

2. UNIFORM MINOR DIAMETER OF NUT.—The minor diameter of the threaded hole or nut, of any given size and pitch, is the same for fits of classes 1 to 4, inclusive, but is larger for class 5 fit.

3. LENGTH OF ENGAGEMENT.—A length of engagement equal to the basic major diameter is the basis of the tolerances specified herein for screw-thread products.

4. TOLERANCES.[3] —(*a*) The tolerances specified represent the extreme variations permitted on the product.

(*b*) The tolerance on the nut is plus, and is applied from the basic size to above basic size.

(*c*) The tolerance on the screw is minus, and is applied from the maximum screw size to below the maximum screw size.

(*d*) The pitch diameter tolerances for a screw and nut of a given class of fit are the same, except for class 5.

(*e*) Pitch diameter tolerances include lead and angle variations. (See footnote 1, tables 2, 3, 4, and 5.)

(*f*) The tolerances on the major diameters of class 1 fit or class 2 fit screws are twice the tolerance values allowed on the pitch diameters of the same respective

[3] Recommendations and explanations regarding the applications of tolerances are given in appendix 1.

classes and pitches with the following exception: On class 2 fit, American National coarse-thread series, externally threaded parts of unfinished, hot-rolled material, the same tolerances on major diameter are applied as on class 1 fit screws.

The tolerances on the major diameters of classes 3, 4, and 5 screws, American National coarse-thread series, are the same as those on class 2 finished screws of the same thread series; and for the American National fine-thread series are the same as those on class 2 of that series.

(*g*) The minimum minor diameter of a screw of a given pitch is such as to result in a basic flat ($\frac{1}{8} \times p$) at the root when the pitch diameter of the screw is at its minimum value. When the maximum screw is basic, the minimum minor diameter of the screw will be below the basic minor diameter by the amount of the specified pitch diameter tolerance.

(*h*) The maximum minor diameter of a screw of a given pitch may be such as results from the use of a worn or rounded threading tool, when the pitch diameter is

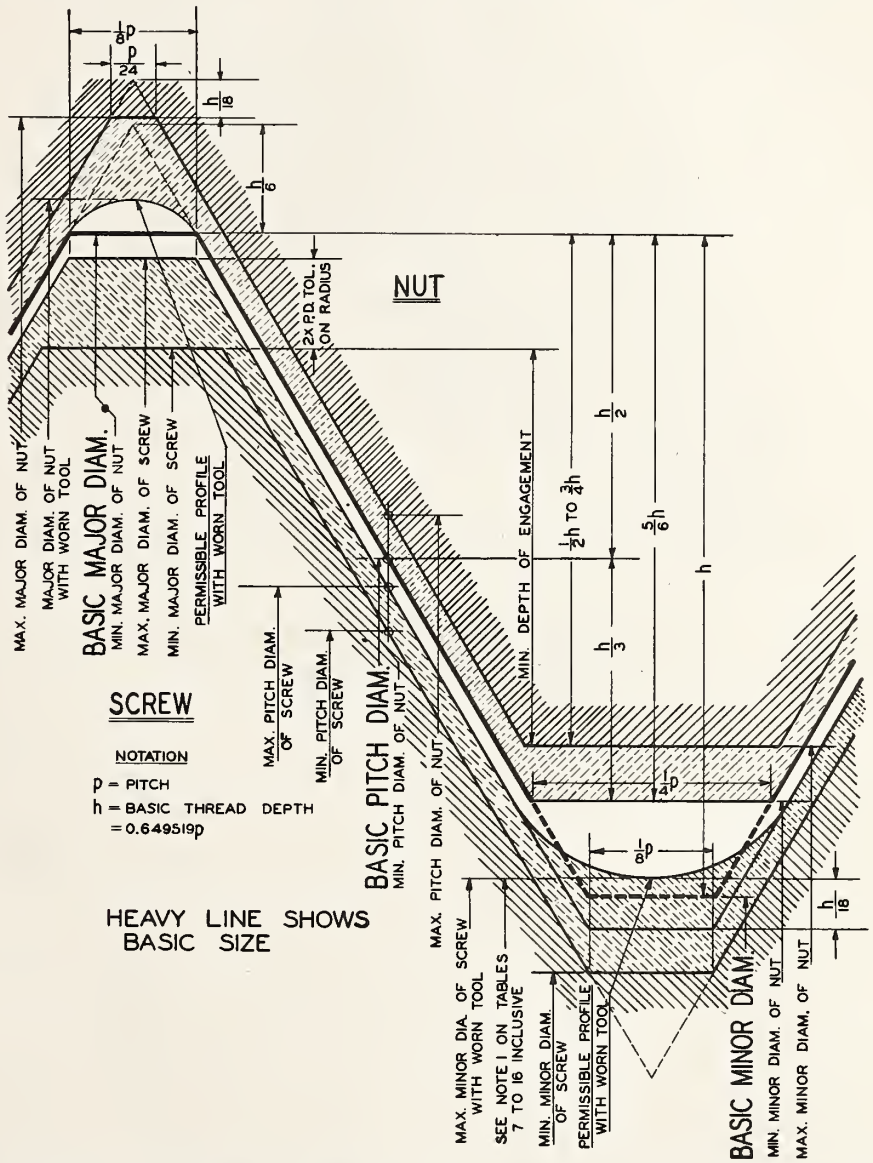

FIGURE 4.—*Illustration of tolerances, allowance (neutral space), and crest clearances for class 1 fit.*

at its maximum value. In no case, however, should the form of a thread, as results from tool wear, be such as to cause the screw to be rejected on the maximum minor diameter by a "go" thread ring gage, the minor diameter of which is equal to the minimum minor diameter of the nut.

(*i*) The maximum major diameter of the nut of a given pitch is such as to result in a flat equal to one-third of the basic flat ($\frac{1}{24} \times p$) when the pitch diameter of the nut is at its maximum value. When the minimum nut is basic, its maximum major diameter will be above the basic major diameter by the amount of the specified pitch diameter tolerance plus two-ninths of the basic thread depth.

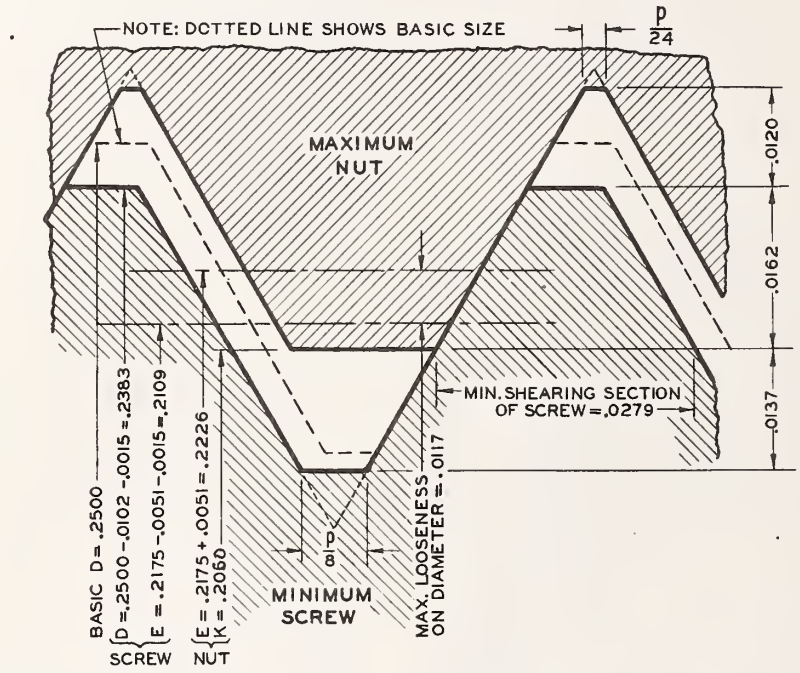

FIGURE 5.—*Illustration of loosest condition for class 1 fit, one-fourth inch, 20 threads.*

NOTATION

D = major diameter
E = pitch diameter
K = minor diameter
$h = 0.0325$ = basic thread depth

(*j*) The nominal minimum major diameter of a nut is the basic major diameter. In no case, however, should the minimum major diameter of the nut, as results from a worn tap or cutting tool, be such as to cause the nut to be rejected on the minimum major diameter by a "go" thread plug gage made to the standard form at the crest.

(*k*) Tolerances are based on the pitch of the thread and a length of engagement equal to the basic major diameter, but may be used for lengths of engagement up to 1½ diameters. (For longer lengths of engagement see section V, p. 105.)

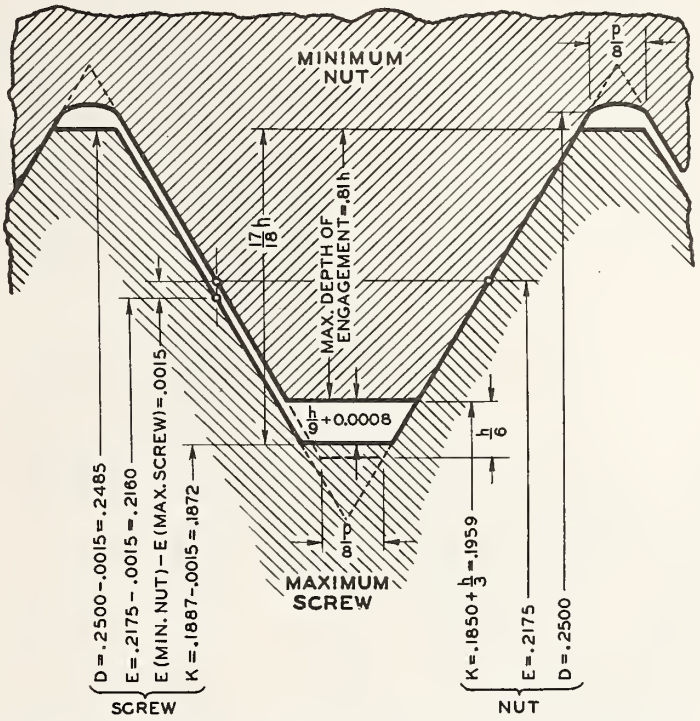

FIGURE 6.—*Illustration of tightest condition for class 1 fit, one-fourth inch, 20 threads.*

NOTATION

D = major diameter
E = pitch diameter
K = minor diameter
$h = 0.0325$ = basic thread depth

(b) CLASSIFICATION OF FITS

1. CLASS 1 FIT.—(*a*) *Definition.*—The class 1 fit is intended to cover the manufacture of threaded parts where quick and easy assembly is necessary, and where an allowance is required.

TABLE 2.—*Class 1 fit, allowances and tolerances for screws and nuts*

Threads per inch	Allowances	Pitch-diameter tolerances[1]	Lead errors consuming one-half of pitch-diameter tolerances[2]	Errors in half-angle consuming one-half of pitch-diameter tolerances	
1	2	3	4	5	
	Inch	*Inch*	*Inch*	*Deg.*	*Min.*
80	0.0007	0.0024	0.0007	3	40
72	.0007	.0025	.0007	3	26
64	.0007	.0026	.0008	3	10
56	.0008	.0028	.0008	3	0
48	.0009	.0031	.0009	2	50
44	.0009	.0032	.0009	2	41
40	.0010	.0034	.0010	2	36
36	.0011	.0036	.0010	2	28
32	.0011	.0038	.0011	2	19
28	.0012	.0043	.0012	2	18
24	.0013	.0046	.0013	2	6
20	.0015	.0051	.0015	1	57
18	.0016	.0057	.0016	1	58
16	.0018	.0063	.0018	1	55
14	.0021	.0070	.0020	1	52
13	.0022	.0074	.0021	1	50
12	.0024	.0079	.0023	1	49
11	.0026	.0085	.0025	1	47
10	.0028	.0092	.0027	1	45
9	.0031	.0100	.0029	1	43
8	.0034	.0111	.0032	1	42
7	.0039	.0124	.0036	1	39
6	.0044	.0145	.0042	1	40
5	.0052	.0169	.0049	1	37
4½	.0057	.0184	.0053	1	35
4	.0064	.0204	.0059	1	33

[1] The tolerances specified for pitch diameter include all errors of pitch diameter, lead, and angle. The full tolerance cannot, therefore, be used on pitch diameter unless the lead and angle of the thread are perfect. Columns 4 and 5 give, for information, the errors in lead (per length of thread engaged) and in angle, each of which can be compensated for by half the tolerance on the pitch diameter given in column 3. If lead and angle errors both exist to the amounts tabulated, the pitch diameter of a bolt, for example, must be reduced by the full tolerance or it will not pass the "go" gage.

[2] Between any 2 threads not farther apart than the length of engagement.

This class has an allowance on the screw to permit ready assembly even when the threads are slightly bruised or dirty.

(*b*) *Minimum nut basic.*—The pitch diameter of the minimum nut of a given diameter and pitch corresponds to the basic pitch diameter, as specified in the tables of thread series given in section IV, which is computed from the basic major diameter of the thread. The pitch diameter of the minimum nut is the theoretical pitch diameter for that size.

(*c*) *Maximum screw below basic.*[4] —The dimensions of the maximum screw of a given pitch and diameter are below the basic dimensions as specified in the tables of thread series given in section IV, which are computed from the basic major diameter of the threads, by the amount of the allowance given in table 2.

(*d*) *Allowance and tolerance values.*—Allowances and tolerances are specified in table 2.

[4] The maximum minor diameter of the screw is above the basic minor diameter as shown in fig. 4.

2. CLASS 2 FIT.—(*a*) *Definition.*—The class 2 fit is intended to apply to the major portion of threaded work in interchangeable manufacture, where no allowance is required.

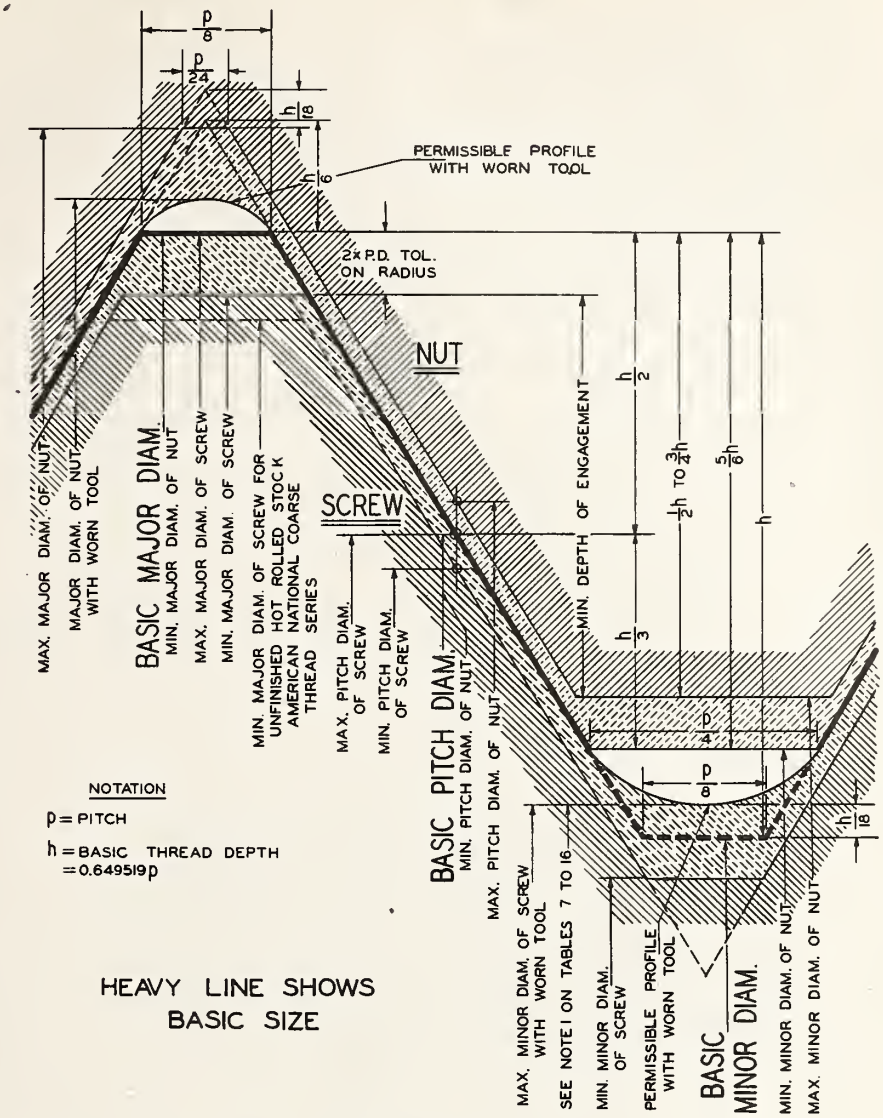

FIGURE 7.—*Illustration of tolerances and crest clearances for class 2 fit.*

(*b*) *Minimum nut basic.*—The pitch diameter of the minimum nut of a given diameter and pitch corresponds to the basic pitch diameter, as specified in tables of thread series given in section IV, which is computed from the basic major diameter of the thread.

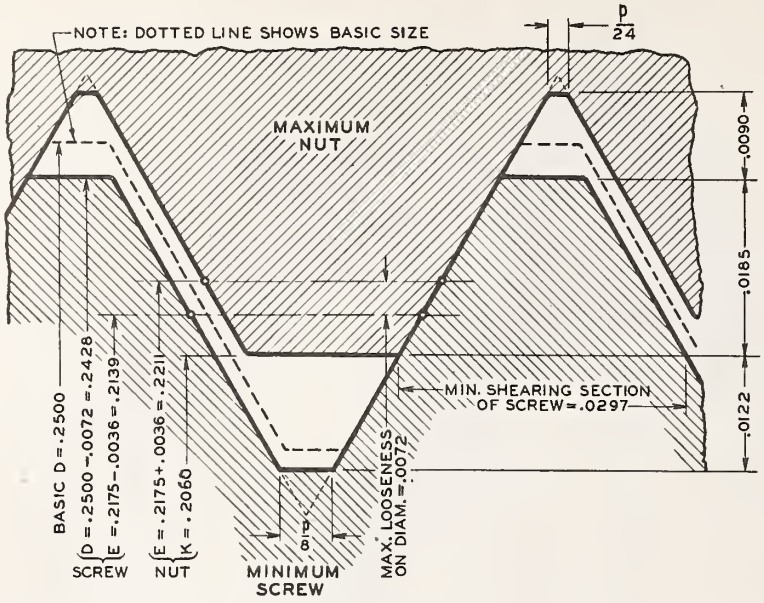

FIGURE 8.—*Illustration of loosest condition for class 2 fit, one-fourth inch, 20 threads.*

NOTATION

D = major diameter
E = pitch diameter
K = minor diameter
$h = 0.0325$ = basic thread depth

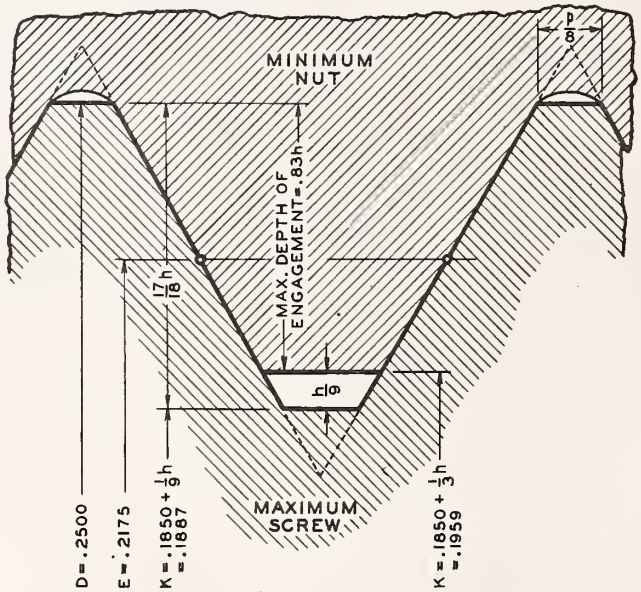

FIGURE 9.—*Illustration of tightest condition for class 2 fit, one-fourth inch, 20 threads.*

NOTATION

D = major diameter
E = pitch diameter
K = minor diameter
$h = 0.0325$ = basic thread depth

TABLE 3.—*Class 2 fit, tolerances for screws and nuts (no allowances)*

Threads per inch	Allowances	Pitch-diameter tolerances [1]	Lead errors consuming one-half of pitch-diameter tolerances [2]	Errors in half-angle consuming one-half of pitch-diameter tolerances	
1	2	3	4	5	
	Inch	*Inch*	*Inch*	*Deg.*	*Min.*
80	0.0000	0.0017	0.0005	2	36
72	.0000	.0018	.0005	2	28
64	.0000	.0019	.0005	2	19
56	.0000	.0020	.0006	2	8
48	.0000	.0022	.0006	2	1
44	.0000	.0023	.0007	1	56
40	.0000	.0024	.0007	1	50
36	.0000	.0025	.0007	1	43
32	.0000	.0027	.0008	1	39
28	.0000	.0031	.0009	1	39
24	.0000	.0033	.0010	1	31
20	.0000	.0036	.0010	1	22
18	.0000	.0041	.0012	1	25
16	.0000	.0045	.0013	1	22
14	.0000	.0049	.0014	1	19
13	.0000	.0052	.0015	1	17
12	.0000	.0056	.0016	1	17
11	.0000	.0059	.0017	1	14
10	.0000	.0064	.0018	1	13
9	.0000	.0070	.0020	1	12
8	.0000	.0076	.0022	1	10
7	.0000	.0085	.0025	1	8
6	.0000	.0101	.0029	1	9
5	.0000	.0116	.0033	1	6
4½	.0000	.0127	.0037	1	5
4	.0000	.0140	.0040	1	4

[1] The tolerances specified for pitch diameter include all errors of pitch diameter, lead, and angle. The full tolerance cannot, therefore, be used on pitch diameter unless the lead and angle of the thread are perfect. Columns 4 and 5 give, for information, the errors in lead (per length of thread engaged) and in angle, each of which can be compensated for by half the tolerance on the pitch diameter given in column 3. If lead and angle errors both exist to the amounts tabulated, the pitch diameter of a bolt, for example, must be reduced by the full tolerance or it will not enter a basic nut or pass the "go" gage.

[2] Between any two threads not farther apart than the length of engagement.

(*c*) *Maximum screw basic.*[5]—The major diameter and pitch diameter of the maximum screw of a given pitch and diameter correspond to the basic dimensions, as specified in tables of thread series given in section IV, which are computed from the basic major diameter of the thread.

(*d*) *Allowance and tolerance values.*—Allowances and tolerances are specified in table 3.

[5] The maximum minor diameter of the screw is above the basic minor diameter, as shown in fig. 7.

3. Class 3 Fit.—*(a) Definition.*—The class 3 fit is intended to apply to the highest grade of interchangeable screw thread work. It is the same in every particular as class 2 fit, except that the tolerances are smaller. Tapped holes within class 3 tolerances are difficult and expensive to produce commercially.

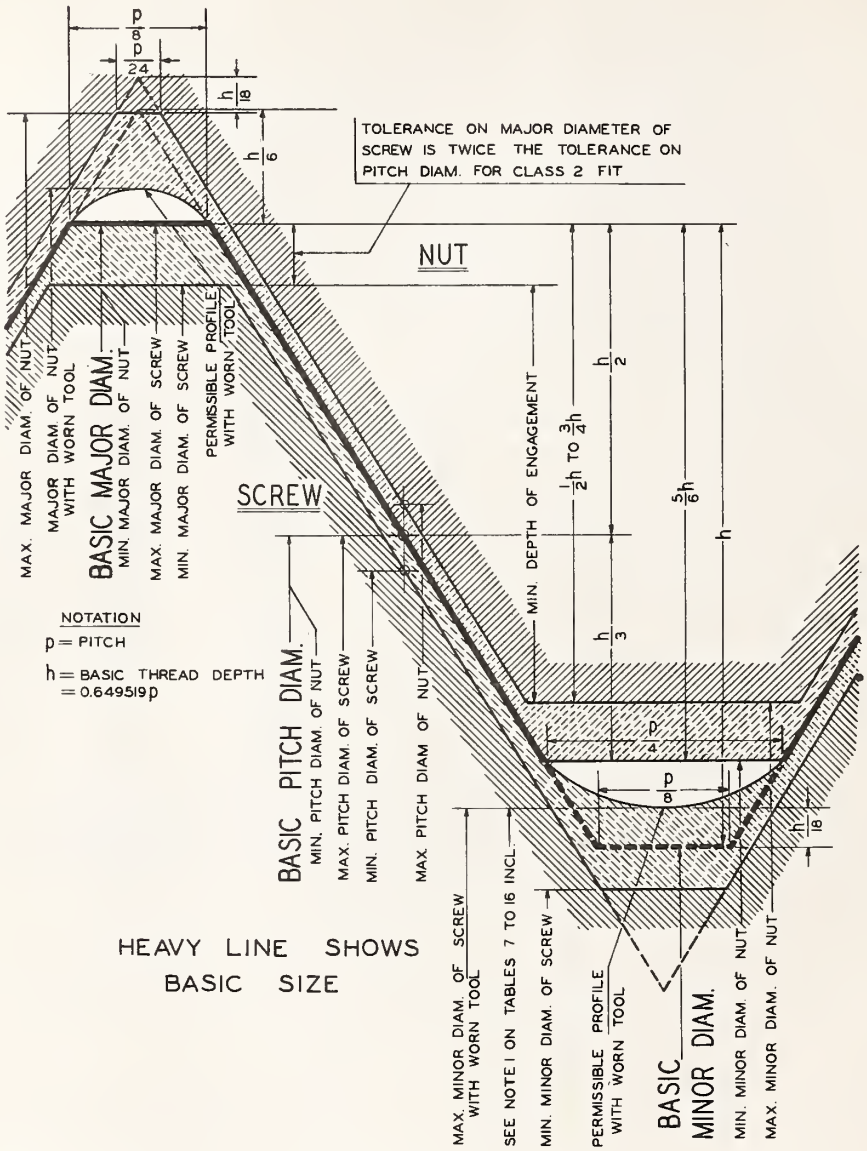

Figure 10.—*Illustration of tolerances and crest clearances for class 3 fit.*

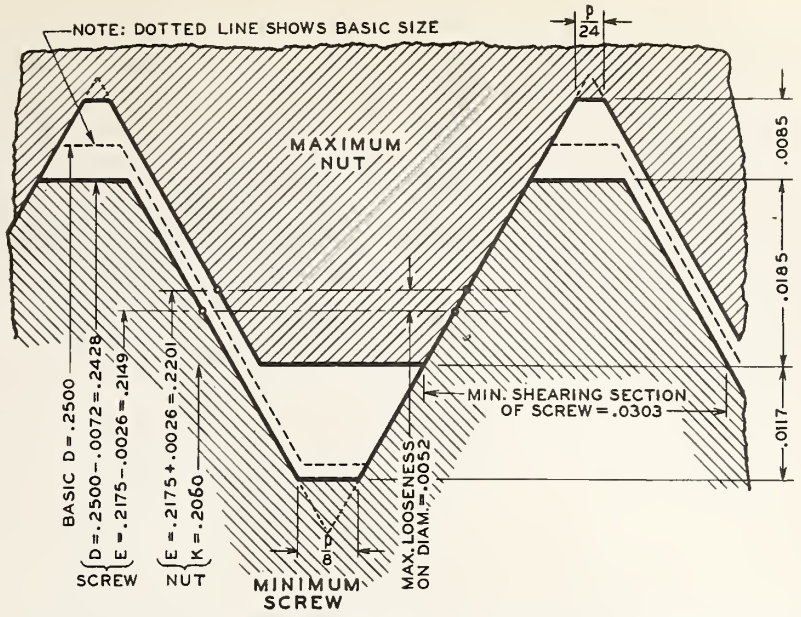

FIGURE 11.—*Illustration of loosest condition for class 3 fit, one-fourth inch, 20 threads.*

NOTATION

D = major diameter
E = pitch diameter
K = minor diameter
h = 0.0325 = basic thread depth

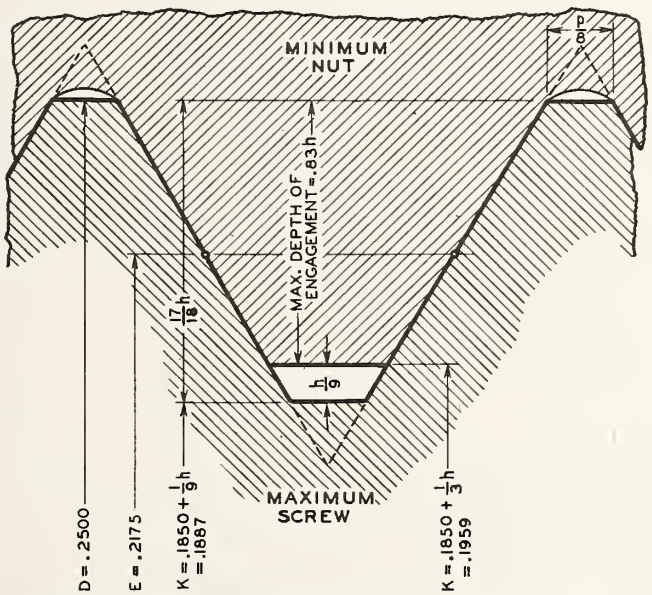

FIGURE 12.—*Illustration of tightest condition for class 3 fit, one-fourth inch, 20 threads.*

NOTATION

D = major diameter
E = pitch diameter
K = minor diameter
h = 0.0325 = basic thread depth

(*b*) *Minimum nut basic.*—The pitch diameter of the minimum nut of a given diameter and pitch corresponds to the basic pitch diameter, as specified in tables of thread series given in section IV, which is computed from the basic major diameter of the thread.

(*c*) *Maximum screw basic.*[6]—The major diameter and pitch diameter of the maximum screw of a given pitch and diameter correspond to the basic dimensions, as specified in tables of thread series given in section IV, which are computed from the basic major diameter of the thread.

(*d*) *Allowance and tolerance values.*—Allowances and tolerances are specified in table 4.

[6] The maximum minor diameter of the screw is above the basic minor diameter, as shown in fig. 10.

TABLE 4.—*Class 3 fit, tolerances for screws and nuts (no allowances)*

Threads per inch	Allowances	Pitch-diameter tolerances[1]	Lead errors consuming one half of pitch-diameter tolerances[2]	Errors in half-angle consuming one-half of pitch-diameter tolerances	
1	2	3	4	5	
	Inch	*Inch*	*Inch*	*Deg.*	*Min.*
80	0.0000	0.0013	0.0004	1	59
72	.0000	.0013	.0004	1	47
64	.0000	.0014	.0004	1	43
56	.0000	.0015	.0004	1	36
48	.0000	.0016	.0005	1	28
44	.0000	.0016	.0005	1	21
40	.0000	.0017	.0005	1	18
36	.0000	.0018	.0005	1	14
32	.0000	.0019	.0005	1	10
28	.0000	.0022	.0006	1	11
24	.0000	.0024	.0007	1	6
20	.0000	.0026	.0008	1	0
18	.0000	.0030	.0009	1	2
16	.0000	.0032	.0009	0	59
14	.0000	.0036	.0010	0	58
13	.0000	.0037	.0011	0	55
12	.0000	.0040	.0012	0	55
11	.0000	.0042	.0012	0	53
10	.0000	.0045	.0013	0	52
9	.0000	.0049	.0014	0	51
8	.0000	.0054	.0016	0	50
7	.0000	.0059	.0017	0	47
6	.0000	.0071	.0020	0	49
5	.0000	.0082	.0024	0	47
4½	.0000	.0089	.0026	0	46
4	.0000	.0097	.0028	0	44

[1] The tolerances specified for pitch diameter include all errors of pitch diameter, lead, and angle. The full tolerance cannot, therefore, be used on pitch diameter unless the lead and angle of the thread are perfect. Columns 4 and 5 give, for information, the errors in lead (per length of thread engaged) and in angle, each of which can be compensated for by half the tolerance on the pitch diameter given in column 3. If lead and angle errors both exist to the amounts tabulated, the pitch diameter of a bolt, for example, must be reduced by the full tolerance or it will not enter a basic nut or pass the "go" gage.

[2] Between any 2 threads not farther apart than the length of engagement.

4. CLASS 4 FIT.—(*a*) *Definition.*—The class 4 fit is intended for threaded work requiring a fine snug fit, and where a screw driver or wrench may be necessary for assembly. In the manufacture of screw-thread products belonging in this class it will be necessary to use precision tools,[7] gages made to special tolerances for this class (see table 9, p. 37), and other refinements. This class should, therefore, be used only in cases where requirements of the mechanism being produced are exacting, or where special conditions require screws having a precision fit. In order to secure the fit desired it may be necessary in some cases to select the parts when the product is being assembled.

(*b*) *Minimum nut basic.*—The pitch diameter of the minimum nut of a given diameter and pitch corresponds to the basic pitch diameter, as specified in tables of thread series given in section IV, which is computed from the basic major diameter of the thread.

[7] Including positive control of taps and dies by means of a lead screw. See p.

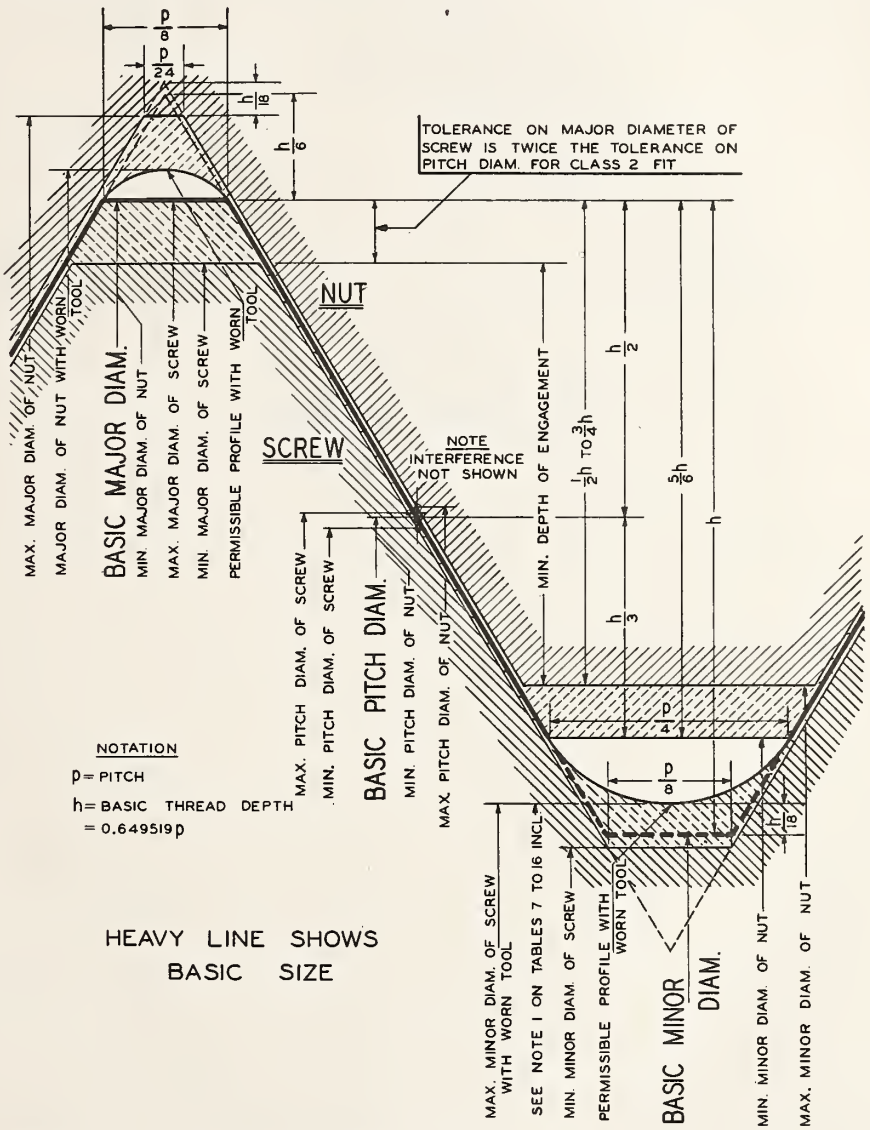

FIGURE 13.—*Illustration of tolerances, allowance (interference), and crest clearances for class 4 fit.*

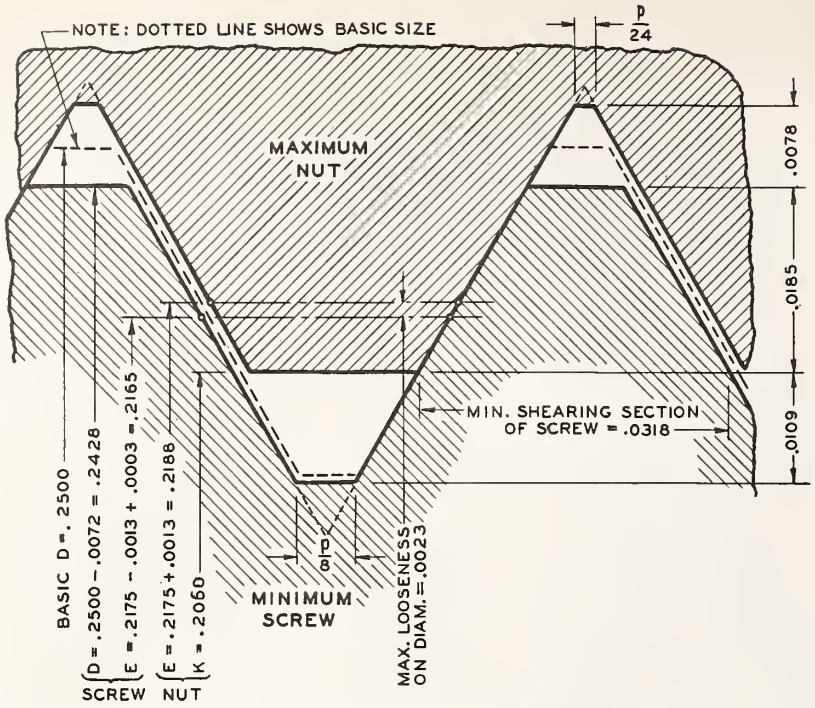

FIGURE 14.—*Illustration of loosest condition for class 4 fit, one-fourth inch, 20 threads.*

NOTATION

D = major diameter
E = pitch diameter
K = minor diameter
h = 0.0325 = basic thread depth

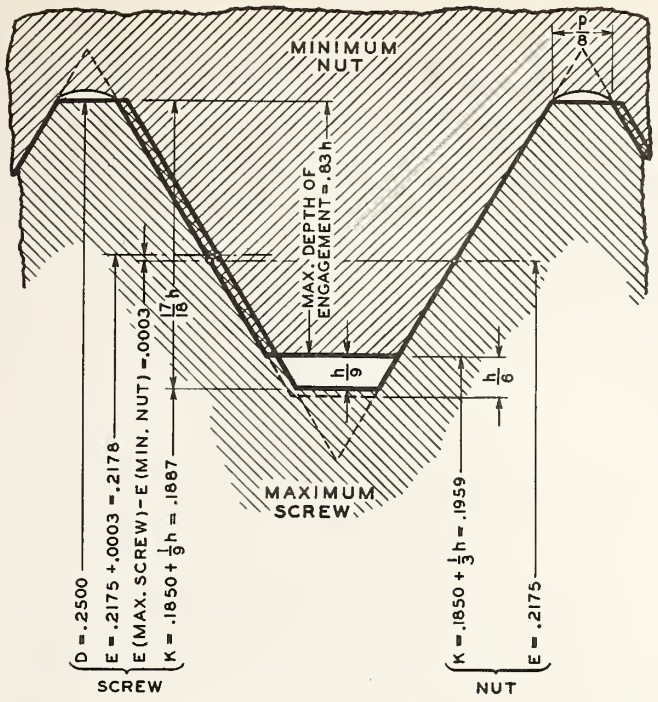

FIGURE 15.—*Illustration of tightest condition for class 4 fit, one-fourth inch, 20 threads.*

NOTATION

D = major diameter
E = pitch diameter
K = minor diameter
h = 0.0325 = basic thread depth

(c) *Maximum screw above basic*.—The pitch diameter of the maximum screw of a given diameter and pitch is above the basic dimensions as specified in tables of thread series given in section IV, which are computed from the basic major diameter of the thread, by the amount of the allowance (interference) specified in table 5.

(d) *Allowance and tolerance values*.—Allowances and tolerances are specified in table 5.

TABLE 5.—*Class 4 fit, allowances and tolerances for screws and nuts*

Threads per inch	Interferences or negative allowances	Pitch-diameter tolerances[1]	Lead errors consuming one-half of pitch-diameter tolerances[2]	Errors in half-angle consuming one-half of pitch-diameter tolerances	
1	2	3	4	5	
	Inch	*Inch*	*Inch*	*Deg.*	*Min.*
28	0.0002	0.0011	0.0003	0	35
24	.0003	.0012	.0003	0	33
20	.0003	.0013	.0004	0	30
18	.0003	.0015	.0004	0	31
16	.0004	.0016	.0005	0	29
14	.0004	.0018	.0005	0	29
13	.0004	.0019	.0005	0	28
12	.0005	.0020	.0006	0	28
11	.0005	.0021	.0006	0	26
10	.0006	.0023	.0007	0	26
9	.0006	.0024	.0007	0	25
8	.0007	.0027	.0008	0	25
7	.0008	.0030	.0009	0	24
6	.0009	.0036	.0010	0	25
5	.0010	.0041	.0012	0	23
4½	.0011	.0044	.0013	0	23
4	.0013	.0048	.0014	0	22

[1]The tolerances specified for pitch diameter include all errors of pitch diameter, lead, and angle. The full tolerance cannot, therefore, be used on pitch diameter unless the lead and angle of the thread are perfect. Columns 4 and 5 give, for information, the errors in lead (per length of thread engaged) and in angle, each of which can be compensated for by half the tolerance on the pitch diameter given in column 3. If lead and angle errors both exist to the amounts tabulated, the pitch diameter of a bolt, for example, must be reduced by the full tolerance or it will not pass the "go" gage.

[2]Between any 2 threads not farther apart than the length of engagement.

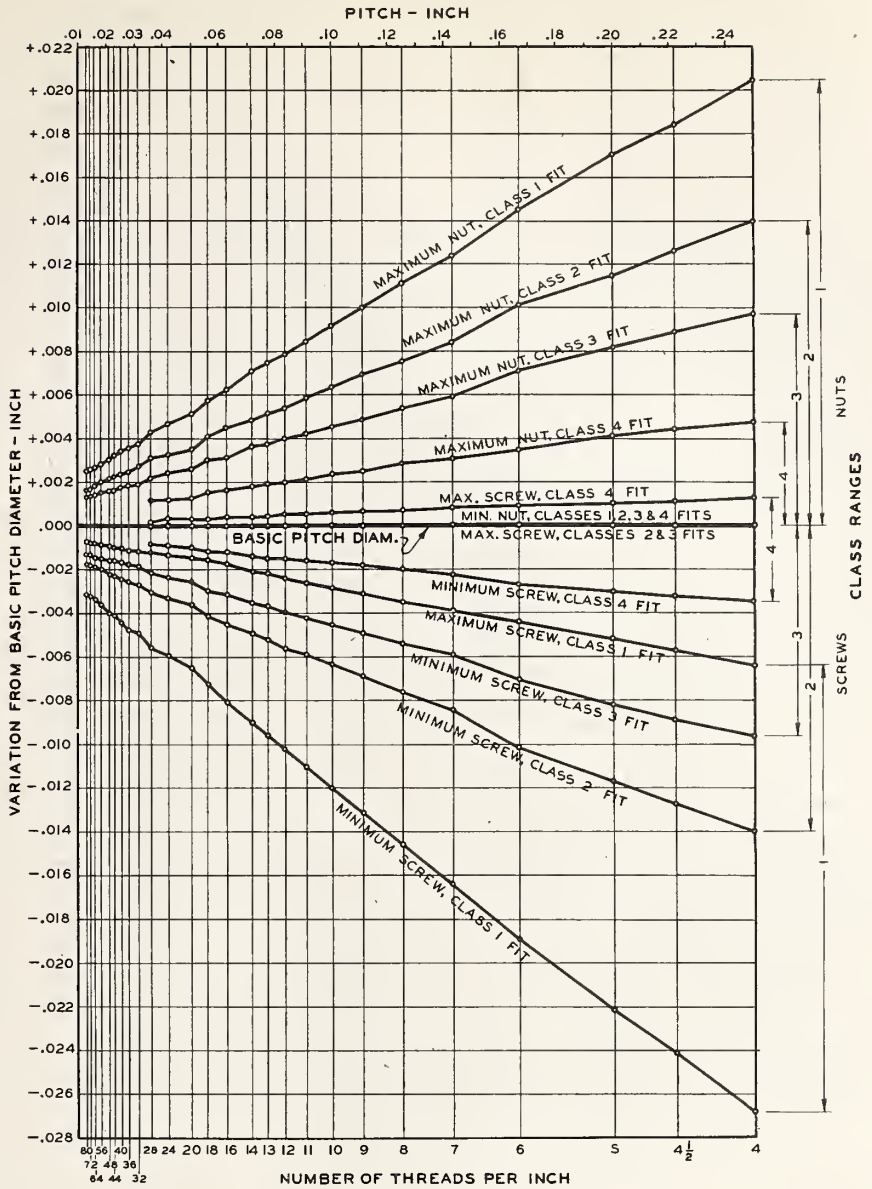

FIGURE 16.—*Relation of maximum and minimum pitch diameters of classes 1, 2, 3, and 4 fits to basic pitch diameters.*

5. CLASS 5 FIT.—(*a*) *Definition.*—The class 5 fit is intended to cover the manufacture of interchangeable threaded studs and holes which are to be assembled permanently by a turning force. The thread form of the tapped hole is modified by truncating the crest of the thread a greater amount than that specified for threads of strictly American National form. This truncation is such that the minimum depth of thread engagement is one half of the basic thread depth, to provide clearance space into which the metal can flow. The maximum depth of engagement is governed by the tolerances specified for the major diameter of the stud and the minor diameter of the tapped hole.

These specifications for steel studs set in hard materials are intended for general application, but it is recognized that differences in materials, in methods of producing studs, or in requirements as to

assembly torque, may require selective assembly or modification of dimensional limits in some cases.

(*b*) *Minimum tapped hole.*—The pitch diameter of the minimum threaded hole corresponds to the basic size, the tolerances being applied above the basic size.

(*c*) *Maximum and minimum stud above basic.*—The pitch diameter of both the maximum and minimum studs of a given size and pitch are above the basic dimensions as specified in tables of thread series given in section IV, which are computed from the basic major diameter of the thread. The maximum major diameter of the stud is basic.

(*d*) *Length of engagement.*—A length of engagement equal to one and one half times the basic major diameter for studs set in hard materials, is the basis of the tolerances and allowances specified herein. (For studs set in soft materials, a length of engagement of two diameters is desirable especially when subject to alternating stresses or to vibration).

(*e*) *Minimum interferences.*—The minimum interferences specified are such that a wrench-tight fit will result in all cases. If the thread surfaces are smooth and thread form is maintained, these interferences will permit disassembly and reassembly of the same stud and hole as many as four times and still produce a wrench-tight fit.

(*f*) *Maximum interferences.*—The maximum interferences specified are such that all conditions necessary for a good wrench fit are fulfilled. If threads are well lubricated with a suitable lute no galling or seizing of the threads will result. Also, mild-steel studs, even of the smaller sizes, will not break if the rate of assembly is not excessive.

When a mixture of white lead and oil is used as a lute it is important that it be of a thick fluid consistency in order to prevent galling or seizing, particularly when fine threads in hard materials are concerned, and that it be applied liberally. If a lute consisting of 40 percent zinc dust, which has passed through a 200-mesh sieve, and 60 percent petrolatum is used, the tendency for the threads to gall or seize with maximum interference is materially reduced.

(*g*) *Allowance and tolerance values.*—Allowances and tolerances are specified in tables 6, and 7, for coarse-threaded and fine-threaded studs set in hard materials—namely, cast iron, steel, and bronze. These are based upon data obtained in an experimental investigation and fulfill the conditions outlined in the above specifications. The system is predicated upon the definite use of W thread plug and ring gages to control thread sizes of both studs and tapped holes. That is, the maximum interferences have been increased, in general (with slight deviations for smoothing of tables), by the diameter equivalent of pitch diameter, lead, and angle gage tolerances of W gages. This equivalent is taken for one W gage, and therefore represents an average condition.

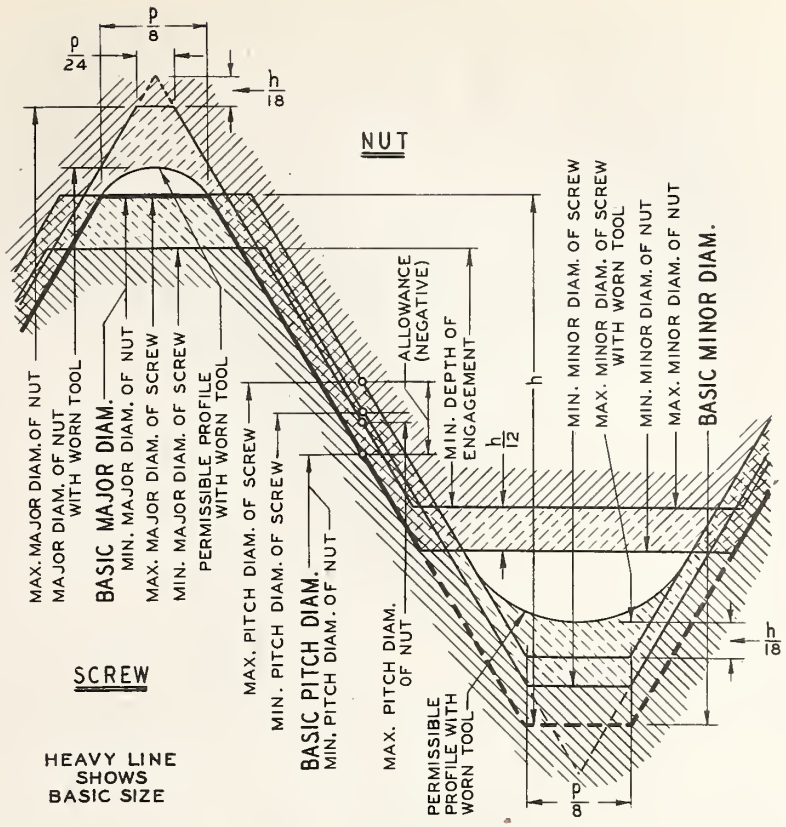

FIGURE 17.—*Illustration of tolerances, allowance, and crest clearances for class 5 fit for unreaded studs.*

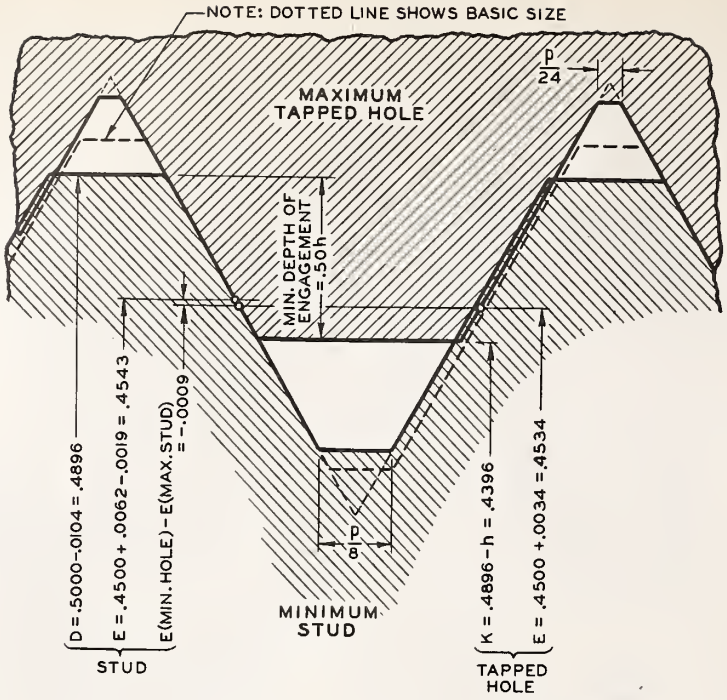

FIGURE 18.—*Illustration of loosest condition for class 5 fit for threaded studs, one-half inch, 13 threads, set in hard materials.*

NOTATION

D = major diameter.
E = pitch diameter.
K = minor diameter.
h = 0.0500 = basic thread depth.

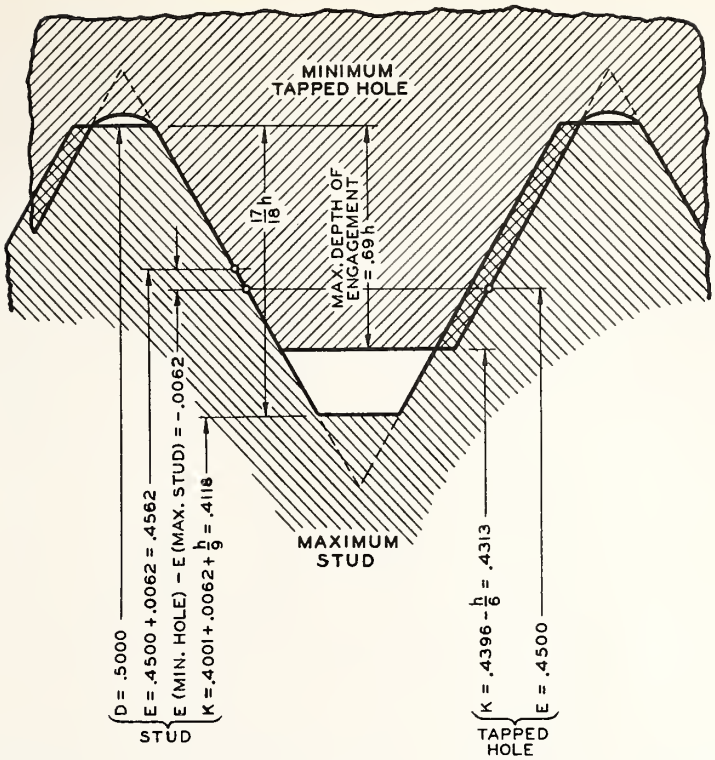

FIGURE 19.—*Illustration of tightest condition for class 5 fit for threaded studs, one-half inch, 13 threads, set in hard materials.*

NOTATION

D = major diameter.
E = pitch diameter.
K = minor diameter.
h = 0.0500 = basic thread depth.

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TABLE 6.—*Class 5 fit for threaded studs, allowances and tolerances for studs and tapped holes, coarse threaded studs in hard materials*

Sizes	Threads per inch	Interference on pitch diameter		Pitch diameter tolerances	
		Minimum	Maximum	Stud [1]	Tapped hole [2]
1	2	3	4	5	6
		Inch	*Inch*	*Inch*	*Inch*
5/16	18	0.0005	0.0046	0.0015	0.0026
3/8	16	.0005	.0051	.0016	.0030
7/16	14	.0007	.0057	.0018	.0032
1/2	13	.0009	.0062	.0019	.0034
9/16	12	.0011	.0066	.0020	.0035
5/8	11	.0012	.0069	.0021	.0036
3/4	10	.0013	.0073	.0023	.0037
7/8	9	.0013	.0074	.0024	.0037
1	8	.0013	.0075	.0025	.0037
1 1/8	7	.0014	.0076	.0025	.0037
1 1/4	7	.0014	.0076	.0025	.0037
1 3/8	6	.0014	.0076	.0025	.0037
1 1/2	6	.0016	.0081	.0025	.0040

[1] These are class 4 tolerances from 5/16 to 7/8 in. inclusive. Tolerances for larger sizes are less than class 4.
[2] These tolerances lie between classes 3 and 4 tolerances.

TABLE 7.—*Class 5 fit for threaded studs, allowances and tolerances for studs and tapped holes, fine-threaded studs in hard materials*

Sizes	Threads per inch	Interference on pitch diameter		Pitch diameter tolerances	
		Minimum	Maximum	Stud [1]	Tapped hole [2]
1	2	3	4	5	6
		Inch	*Inch*	*Inch*	*Inch*
1/4	28	0.0006	0.0039	0.0011	0.0022
5/16	24	.0006	.0042	.0012	.0024
3/8	24	.0008	.0044	.0012	.0024
7/16	20	.0008	.0047	.0013	.0026
1/2	20	.0011	.0050	.0013	.0026
9/16	18	.0011	.0056	.0015	.0030
5/8	18	.0011	.0056	.0015	.0030
3/4	16	.0011	.0059	.0016	.0032
7/8	14	.0011	.0065	.0018	.0036
1	14	.0015	.0069	.0018	.0036
1 1/8	12	.0015	.0075	.0020	.0040
1 1/4	12	.0015	.0072	.0020	.0037
1 3/8	12	.0015	.0067	.0020	.0032
1 1/2	12	.0015	.0062	.0020	.0027

[1] These are class 4 tolerances.
[2] These are class 3 tolerances from 1/4 to 1 1/8 in., inclusive.

3. GAGES[8]

The manufacture and gaging of threaded products has progressed to the point where standardized methods of inspection can be formulated. From the standpoint of economy of effort, and to assure that users of screw-threaded products will apply the same methods of inspection as the manufacturers, it is considered of great importance that the fundamental principles be laid down for future use. The gaging methods herein described are those which have been tested by producers and consumers of screw-thread products with mutual satisfaction.

(a) FUNDAMENTALS

1. OBJECT OF GAGING.—The final results sought by gaging are to secure interchangeability, that is, the assembly of mating parts without selection or fitting of one part to another, and to insure that the product conforms to the specified dimensions within the limits of variation establishing the closest and loosest conditions of fit permissible in any given case, as provided for in the foregoing specifications. This requires the use of gages representing the limit of maximum metal, known as "go" gages, which control the minimum looseness or maximum tightness in the fit of mating parts, and which accordingly control interchangeability; and the use of gages representing the limit of minimum metal, known as "not go" gages, which limit the amount of looseness between mating parts, and thus control in large measure the proper functioning of the parts.

Gages should be used to assure production of satisfactory parts. After manufacture gages may be used to cull out unsatisfactory parts.

2. PURPOSE OF "GO" AND "NOT GO" GAGES.—The "go" gages control the extent of the tolerance in the direction of the limit of maximum metal, and represent the maximum limit of external threads and the minimum limit of internal threads. To pass inspection, parts must be acceptable to proper "go" gages, and such mating parts will always assemble. Successful interchangeable manufacturing has been carried on for many years with the use of "go" gages only.

"Not go" gages control the extent of the tolerance in the direction of the limit of minimum metal, and represent the minimum limit of external threads and the maximum limit of internal threads. The "not go" thread gage shall be permitted to enter or to be entered a distance equal to, or less than, the length of the standard "not go" thread gage, provided that the gage encounters or reaches a snug fit condition on or before the third thread for external or internal threads, and that the snug fit is maintained in the remaining travel of the gage, but is *not* obtained by the "not go" thread plug gage bottoming in the hole, or the "not go" thread ring gage abutting a shoulder.[9] This requirement is to preclude any possibility of accepting internal threads that are oversize on pitch diameter for more than three threads, or accepting external threads that are undersize, at the entering end, for more than three threads. The requirements of extreme applications such as exceptionally thin or ductile material, small number of threads, etc., may necessitate modification of this practice. The length of the "not go" thread gages as used for the above inspection will be that prescribed in Commercial Standard CS8—41, Gage Blanks (see footnote 10, p. 30). In the event that "not go" thread gages on hand do not conform to the length specified in CS8—41, the functioning will be based on a scale measurement to the length prescribed in CS8—41.

There is a broad, general principle in regard to limit gages which should be kept in mind; a "go" gage should check simultaneously as many elements as possible, a "not go" gage, to be effective, can check but one element. By "effective inspection" is meant assurance that specified requirements in regard to size are not exceeded. A "not go" thread gage made to check the pitch diameter is usually sufficient for practical

[8] This subsection has been extensively revised, and is no longer in complete agreement with ASA B1.2—1941 "Screw Thread Gages and Gaging," published by the A.S.M.E., 29 West 39th St., New York, N.Y., (60c).

[9] With this practice the gage is a minimum-metal-limit gage rather than strictly a "not go" gage. This practice does not apply to classes 4 and 5, for which the "not go" gage shall stop at 1½ turns or less.

purposes. In order that the "not go" gage may check pitch diameter only, it is necessary that the crest of the thread be removed so that the major diameter of the plug gage shall be less than that specified for the "go" plug gage and the minor diameter of the ring gage shall be greater than that specified for the "go" ring gage. A correspondingly greater width of relief should be provided at the root of the thread of the "not go" gage than of the "go" gage.

The truncation of the major diameter of the thread of the "not go" thread-plug gage shall be such that the width of flat will be approximately equal to $p/4$, and the truncation of the minor diameter of the thread of the "not go" thread-ring gage shall be such that the width of flat will be $3p/8$. (See "thread form of thread plug and ring gages," p. 32.) On account of manufacturing conditions incidental to the production of general purpose nuts it may be necessary, upon agreement between the manufacturer and the user, to modify this practice.

3. Gage Classification.—The limiting dimensions of the threaded parts to be produced should be represented in: (*a*) Gages used in checking the product as it is machined, known as "working gages"; (*b*) gages for use in the acceptance of the product, known as "inspection gages"; and (*c*) gages used to determine the accuracy of the two preceding classes of gages, known as "master gages".

4. Gages Used To Measure the Product.—The gages used to check the product may be divided into two general types: "Mechanical" and "optical." Both types, however, are controlled by the master gages. Most of the product accepted by one type of gaging with a correct gage will be accepted by the other. It should be pointed out, however, that those parts which are near either rejection point may be accepted by one system and rejected by the other.

(*a*) *Mechanical gages.*—Mechanical gages ordinarily comprise the inspection and working gages as above defined, and these two classes are generally of the same design. The dimensions of inspection gages are such that they represent very nearly the extreme limits of the part. It is recommended that, when successive inspections are required, the working gages, either by design or selection, be of such dimensions that they are inside the limits of the gages used in succeeding inspections.

Standard designs for certain types of mechanical gages are available in the report of the American Gage Design Committee, U. S. Department of Commerce Commercial Standard No. CS8—41, "Gage Blanks." [10]

(*b*) *Optical gages.*—When gages of the optical type are employed the elements of wear and "feel" are not involved, but there may be observational errors.

5. Gages for Reference.—(*a*) *Master gage.* The master gage is a thread-plug gage which represents the physical dimensions of the nominal or basic size of the part. It clearly establishes the minimum size of the threaded hole and the maximum size of the screw at the point at which interference between mating parts begins. A master gage shall be accompanied by a record of its measurement.

(*b*) *Setting gage (check gage).*—A setting gage is a thread-plug gage to which adjustable thread-ring gages, thread-snap gages, and other thread comparators are adjusted for size. Threaded setting plug gages are of two standard designs, which are designated as "full-form setting plugs" and "truncated setting plugs."

The full-form setting plug is one having a major diameter corresponding to the maximum major diameter of the screw. It is commonly used for setting thread snap gages, and is also used for setting adjustable thread ring gages to size, when adequate facilities are available for checking the thread form and clearance at the major diameter. (See "procedure", p. 39.)

The truncated setting plug of standard design (see Commercial Standard CS8—41, p. 19) is the same as the full-form setting plug except that the crest of the thread is truncated for one-half, or slightly less, of the length of the gage, giving a full portion and a truncated portion, as specified in par. 3, p. 34. In adjusting thread

[10] For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. 15¢.

ring gages to size, the truncated portion controls the pitch diameter, and the full portion assures that proper clearance is provided at the major diameter of the ring gage. In using the truncated setting plug, the ring gage should be adjusted to fit the full portion, after which the fit of the gage on the truncated portion should be determined. If the thread form of the ring gage is satisfactory, there will be a snug fit with very slight or no shake or play. In the case of a worn thread ring gage, the presence of shake or play on the truncated portion indicates that the sides of the thread are no longer straight near the root, and the gage should be relapped or discarded.

The ring gage should be given further inspection to determine whether or not the minor diameter is within the specified limits. The minor diameter may be inspected by means of "go" and "not go" plain plug gages.

6. Direction of Tolerances on Gages.—All gages used for the *production* of screw threads and "go" gages used for inspection are to be within the extreme limits of the product. The limiting dimensions specified for screw threads represent the extreme limitation of an acceptable product. The tolerances are those necessary to include all errors or variations in the sizes of *production* tools, gages, and all other manufacturing variations. However, in order to avoid needless controversy on parts close to the minimum metal sizes or "not go" limits, because of possible small differences in sizes of the gages used, the pitch diameter tolerances on all "not go" gages used for *final inspection* and for inspection of purchased product may be outside the product limits *if specifically authorized.* The purchaser (usually the interested Government agency) is the authorizing agent when items such as bolts, nuts, gages, etc., are purchased on specified dimensional requirements. In the case of assembled machines purchased on a performance basis, such as automobiles, trucks, tanks, etc., the manufacturer or contractor is the authorizing agent, and, as such, is free to use such gages and gaging methods as he has found applicable and satisfactory.

The directions of tolerances on gages are stated in detail below, and are summarized in table 8.

7. Temperature at Which Gages Shall be Standard.—*The nominal dimensions of gages and product shall be correct at a temperature of* 68° F (*20° C*).—As gages and products are ordinarily checked at room temperature, whatever it may happen to be, it is desirable that the thermal coefficient of expansion of gages be the same as that of the product on which they are used. Inasmuch as the majority of threaded products consist of iron and steel, and as screw-thread gages are ordinarily made of hardened steel, because of its high wear-resisting qualities, this condition is ordinarily fulfilled without giving it special attention.

8. Measuring Pressure for Three-Wire Measurements.[11]—In measuring the pitch diameter of hardened screw-thread gages by means of wires, and in measuring the wires themselves, the same contact load should be used. A contact load of 1 pound is recommended for pitches finer than 20 threads per inch and 2½ pounds for 20 threads per inch and coarser. It is also recommended as standard practice that wires be measured between a flat contact and a cylindrical contact 0.750 inch in diameter. The contacts shall be of hardened steel, accurately ground and lapped.

(b) SPECIFICATIONS FOR GAGES

The following specifications are for the purpose of establishing definite limits for thread gages rather than for the purpose of specifying the gages required for the various inspection operations:

1. Gage Tolerances.—Screw-thread gages for classes 1, 2, 3, 4, and 5 are classified according to accuracy as W, X, and Y, the W gages being the most accurate. The tolerance limits on W and X gages coincide with the extreme product limits. The tolerance limits on Y "go" gages are placed inside of the extreme product limits to provide allowance for wear of the gages. The tolerances on all "not go" gages,

[11] Methods of measuring pitch diameter of screw-thread gages are described and specifications for wires are given in appendix 2, p. 223.

however, are applied from the extreme product limit. The selection of gages from among these designations for use in the inspection of threaded product depends entirely upon the specifications for the product. See "recommended gage practice", p. 41.

(*a*) *Master gages.*—These shall be plain and thread plug gages made to the basic dimensions as accurately as possible. The variations from basic diameters shall be plus. Each master gage shall be marked with an identification number or symbol, and be accompanied by a record of its measurement, on major diameter, pitch diameter, lead, and angle. In case of question, the deviations of such gages from the exact standard shall be ascertained by the National Bureau of Standards, at Washington 25, D. C.

(*b*) *W gages.*—For the inspection of product of classes 4 or 5, gages made within especially close limits are necessary. The tolerances for such gages, designated as W, are given in table 9. Also, W tolerances on lead and thread angle are applicable to all truncated setting plugs. See table 13.

(*c*) *X gages.*—X gages should be suitable for inspection and setting gages for classes 1, 2, and 3, except that in some cases W gages may be desirable for class 3 full-form setting plugs. The tolerances on these gages are given in table 10. In all cases the tolerances for "go" gages shall be such that the gage does not fall outside of the component maximum metal limit. When a thread-plug gage is used as the "go" gage for checking a tapped hole, it may be larger, but not smaller than the minimum size specified. On the other hand, when a thread-plug gage is used as the "go" setting plug for thread-ring gages or for optical or other comparators, it may be smaller, but never larger than the maximum size of screw.

X tolerances, as given in table 10, are specified for all "not go" gages for classes 1, 2, and 3.

(*d*) *Y gages.*—Y "go" gages should be suitable for inspection and working gages for classes 1 and 2 fits, ¼ in. diameter and larger. For diameters less than ¼ in. X gages should be used. They may also be desired as working gages for classes 2 and 3 fits. The tolerances on these gages are given in table 11.

(*e*) *Tolerances on lead.*—The tolerances on lead given in tables 9 to 11, inclusive, are specified as an allowable variation between any two threads not farther apart than the length of the standard gage, shown in Commercial Standard CS8-41, omitting one full thread at each end of the gage.

(*f*) *Tolerances on angle of thread.*—The tolerances on angle of thread, as specified in tables 9 to 11, inclusive, for the various pitches, are tolerances on one half of the included angle. This insures that the bisector of the included angle will be perpendicular to the axis of the thread within proper limits. The equivalent deviation from the true thread form caused by such irregularities as convex or concave sides of thread, rounded crests, or slight projections on the thread form, should not exceed the tolerances permitted on angle of thread.

2. Thread Form of Thread Plug and Ring Gages.—The specifications for thread form of thread plug and ring gages are stated in detail below, and are summarized in table 8 and figure 20.

(*a*) *"Go" thread gages.*—The major diameter of the "go" thread plug gage is the same as the minimum (basic) major diameter of the nut, with a plus gage tolerance. The minor diameter of the "go" thread ring gage is the same as the minimum minor diameter of the nut or tapped hole with a minus gage tolerance.

A relief (which may be an extension of the sides of the thread to approximately a sharp V) is provided at the root of the "go" thread plug or ring gage, the width of which is not greater than one-fourth of the pitch. The "go" thread ring gage shall clear the maximum major diameter of the screw, and the "go" thread plug gage shall clear the minimum minor diameter of the nut.

(*b*) *"Not go" thread gages.*—The crest of the thread of the "not go" thread plug gage is truncated below its basic major diameter such an amount that the width of the flat at the crest will be equal to one-fourth of the pitch, with a minus gage tolerance. This corresponds to a major diameter which is $\frac{2}{3} \times h$ larger than the pitch diameter of the "not go" thread plug gage. However, for threads of special diameters, pitches, and lengths of engagement, section V, the truncation is such that the major diameter

is the mean of the major diameter of the "go" gage (or basic major diameter) and the pitch diameter of the "not go" thread gage.

The crest of the thread of the "not go" thread ring gage is truncated above the basic minor diameter such an amount that the width of the flat at the crest will be equal to three-eighths of the pitch, with a plus gage tolerance. This corresponds to a minor diameter which is $\frac{1}{3} \times h$ smaller than the pitch diameter of the "not go" thread ring gage. However, for threads of special diameters, pitches, and lengths of engagement, section V, the truncation is such that the minor diameter is the mean of the minor diameter of the "go" thread ring gage and the pitch diameter of the "not go" thread ring gage.

A relief (which in small diameters and fine pitches may be an extension of the sides of the thread to approximately a sharp V) is provided at the root of the "not go" thread plug or ring gage, the width of which is approximately one-fourth of the pitch. Thus, contact of the "not go" thread gage can occur on the sides of the threads, but not on the crest or root. Also the effect of angle error on the fit of the "not go" gage with the product is minimized. The "not go" thread ring gage shall clear the maximum major diameter of the screw, and the "not go" thread plug gage shall clear the minimum minor diameter of the nut. The above requirements are illustrated in figure 20.

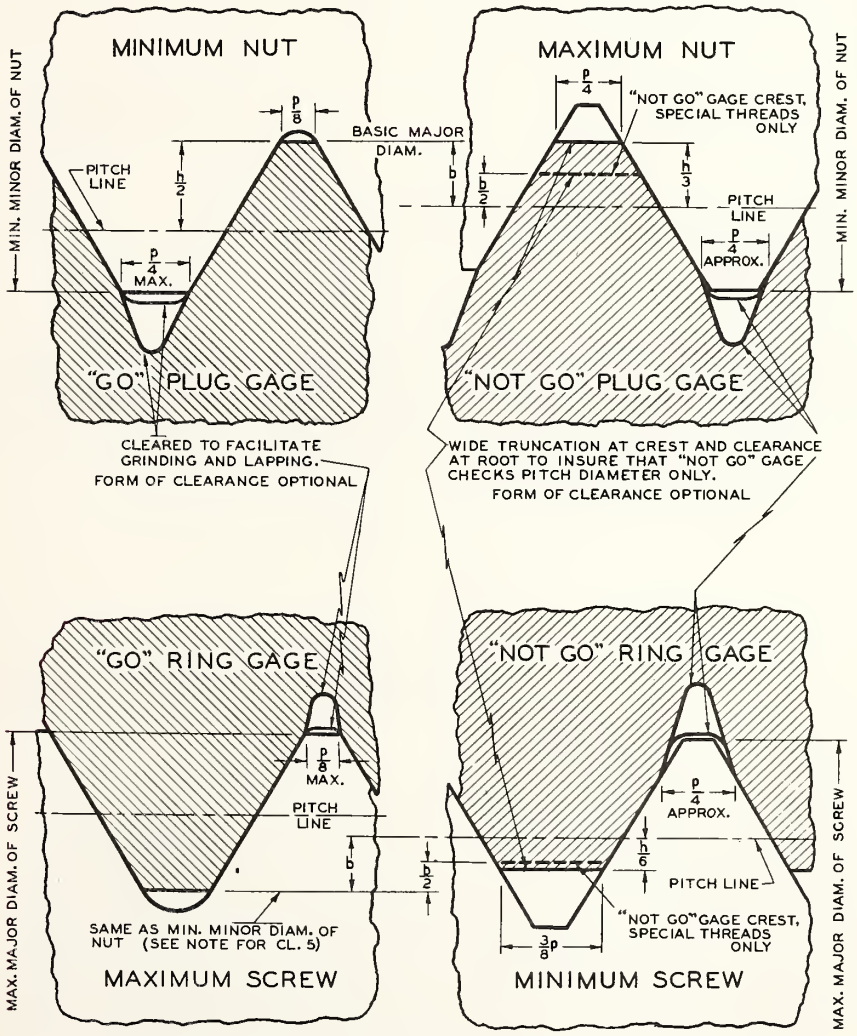

FIGURE 20.—*Thread form of "go" and "not go" thread plug and ring gages.*

NOTE.—For class 5 the minor diameter of the "go" ring gage is larger than that for the other classes by the amount of the allowance.

3. Thread Form of Setting Plug Gages.—The specifications for thread form of setting plug gages are stated in detail below, and are summarized in table 8 and figure 21.

(*a*) *"Go" thread setting plugs.*—(1) The major diameter of the full portion of the "go" thread setting plug corresponds to basic American National form (one-eighth pitch flat) with a plus gage tolerance.

(2) The major diameter of the truncated portion of the "go" setting plug is the same as the minimum major diameter of the screw with a minus gage tolerance.

(3) A relief (which may be an extension of the sides of the thread to approximately a sharp V) is provided at the root of the "go" thread setting plug gage, the width of which is not greater than one-fourth of the pitch.

(*b*) *"Not go" thread setting plugs.*—(1) The major diameter of the full portion of the "not go" thread setting plug shall be the same as that of the "go" thread setting plug of the same nominal size and having American National form, with the exception that in no case shall the amount of truncation from sharp V be less than 0.058*p*. This latter condition might arise in the case of fine pitches and especially wide tolerances. Tolerance shall be taken plus.

(2) The truncation at the major diameter of the truncated portion of the "not go" thread setting plug shall be one-sixth of the basic thread depth from full American National form. Thus, the major diameter is equal to the pitch diameter of the gage plus two-thirds of the basic thread depth, with the tolerance taken minus.

(3) A relief (which may be an extension of the sides of the thread to approximately a sharp V) is provided at the root of the "not go" thread setting plug gage, the width of which is not greater than one-fourth of the pitch.

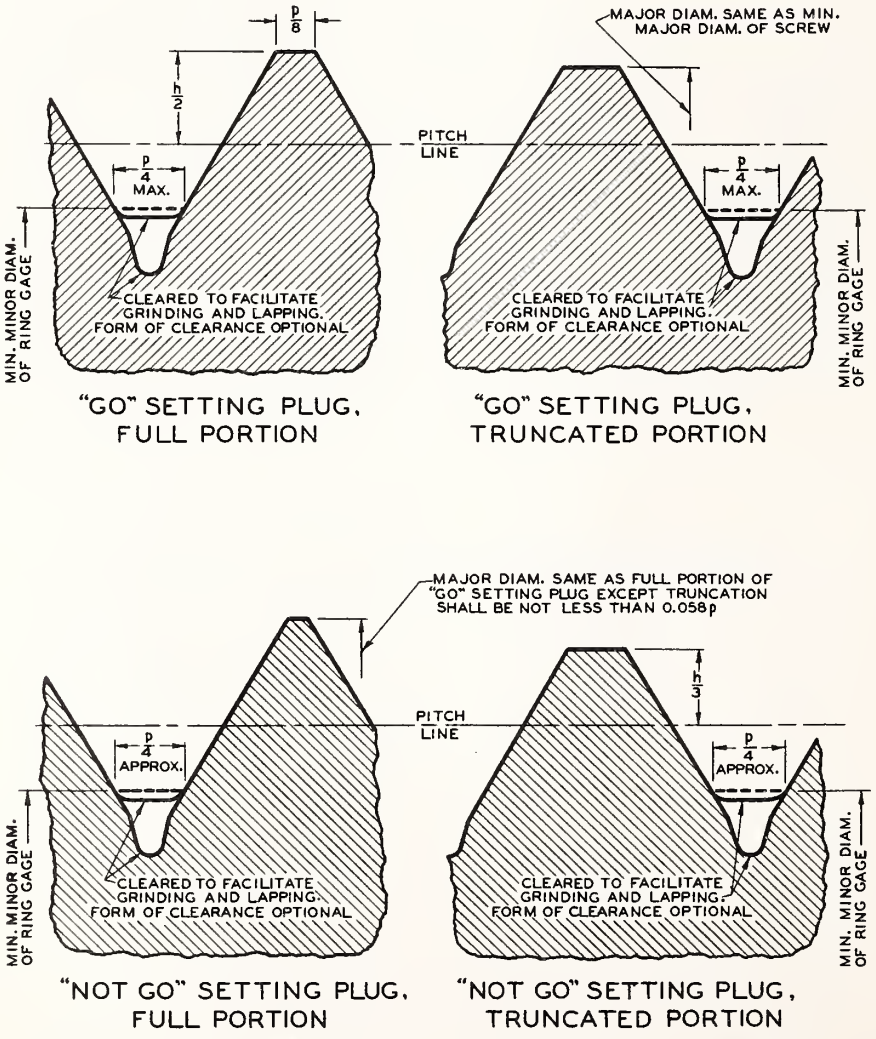

Figure 21.—*Thread form of "go" and "not go" thread setting plug gages.*

TABLE 8.—*Specifications for thread form, major and minor diameters, and direction of gage tolerances of gages for American National form, and straight pipe thread form of thread*[1]

Type of gage	Major diameter			Pitch diameter, direction of tolerance		Minor diameter		
	Dimension D_g	Direction of tolerance	Width of relief[2 3]	Standard	Optional (see par. 6, p. 31)	Dimension K_g	Direction of tolerance	Width of relief[2 3]
"GO" THREAD GAGES								
Thread plug, all threads	Min D_M	+	.....	+	.....	.....	.....	$\frac{P}{4}$ Max.
Thread ring... Standard thread series.. Classes 1,2,3,4..	.....	.....	$\frac{P}{8}$ Max	-	.....	[6]Min K_M	-	.....
Thread ring... Standard thread series.. Class 5	.....	.....	$\frac{P}{8}$ Max	-	.....	Max $E_S - \frac{2h}{3}$	-	.....
Thread ring... Special threads	.....	.....	$\frac{P}{8}$ Max	-	.....	Min K_M	-	.....
Full-form setting plug, all threads	Max $E_S + h$	+	.....	-	.....	.....	.....	$\frac{P}{4}$ Max.
Truncated setting plug, all threads.... Full portion	Max $E_S + h$	+	.....	-	.....	.....	.....	$\frac{P}{4}$ Max.
Truncated setting plug, all threads.... Truncated portion	Min D_S	-	.....	-	.....	.....	.....	$\frac{P}{4}$ Max.
Plain snap gage, all threads	Max D_S	-	.....	.....	.....	.....	.....	.....
Plain plug gage, all threads	.....	.....	.....	.....	.....	Min K_M	+	.....
Plain check plug gages for thread ring gage[4].... "Go"	.....	.....	.....	.....	.....	Min K_g	+	.....
Plain check plug gages for thread ring gage[4].... "Not go"	.....	.....	.....	.....	.....	Max K_g	-	.....
"NOT GO" THREAD GAGES								
Thread plug... Standard thread series	Max $E_M + \frac{2}{3}h$	-	.....	-	+	.....	.....	$\frac{P}{4}$ approx.
Thread plug... Special threads	$\frac{D_g \text{ "go"} + E_g, \text{ "not go"}}{2}$	-	.....	-	+	.....	.....	$\frac{P}{4}$ approx.
Thread ring... Standard thread series	.....	.....	$\frac{P}{4}$ approx.	+	-	[6]Min $E_S - \frac{h}{3}$	+	.....
Thread ring... Special threads	.....	.....	$\frac{P}{4}$ approx.	+	-	$\frac{\text{Min } E_S + K_g, \text{ "go"}}{2}$	+	.....
Full-form setting plug, all threads	[5]Max $E_S + h$	+	.....	+	-	.....	.....	$\frac{P}{4}$ approx.

See footnotes at end of table.

TABLE 8.—*Specifications for thread form, major and minor diameters, and direction of gage tolerances of gages for American National form, and straight pipe thread form of thread*[1]—Continued

Type of gage	Major diameter			Pitch diameter, direction of tolerance		Minor diameter		
	Dimension D_g	Direction of tolerance	Width of reiief[2 3]	Standard	Optional (see par. 6, p. 31)	Dimension K_g	Direction of toierance	Width of relief[2 3]
"NOT GO" THREAD GAGES—Continued								
Truncated setting plug, all threads... Full portion.....	[5]Max $E_S + h$	+	.....	+	-	.....	.....	$\frac{p}{4}$ approx.
Truncated setting plug, all threads... Truncated portion...	Min $E_S + \frac{2}{3}h$	-	.....	+	-	.....	.....	$\frac{p}{4}$ approx.
Plain snap gage, ail threads.....	Min D_S	+	.....	.....	.....	.....	.....	.....
Plain piug gage, all threads.....	.....	.....	.....	.....	.....	Max K_N	.....	.....
Plain check plug gages for thread ring gage..... "Go".....	.....	.....	.....	.....	.....	Min K_g	+	.....
Plain check plug gages for thread ring gage..... "Not Go"..	.....	.....	.....	.....	.....	Max K_g	-	.....

[1]The symbols used in this tabie are as follows:

h = basic depth of thread { = 0.649519p for American National form. = 0.666025p for straight pipe thread form, except Dryseai. (See table 72, col. 3, p. 136.)

p = pitch
D_g = major diameter of gage.
D_N^g = major diameter of nut.
D_S = major diameter of screw.
E_g = pitch diameter of gage.
E_N^g = pitch diameter of nut.
E_S = pitch diameter of screw.
K_g = minor diameter of thread ring gage.
K_N^g = minor diameter of nut.

[2]The "go" and "not go" thread ring gages shall ciear the maximum major diameter of the screw. The "go" and "not go" thread plug gages shall ciear the minimum minor diameter of the nut.

[3]The width of reiief on "go" gages for straight pipe threads is $p/9$, and on "not go" gages is $p/4$.

[4]For the minor diameter of adjustable thread ring gages, "go" and "not go" piain cyiindrical check plug gages made to XX tolerances are required for sizes ½ in. and iess, and are desirabie for iarger sizes. See table 12.

[5]The truncation shall be not iess than 0.058p.

[6]For straight pipe thread ring gages, K_g = Max. $E_S - h$ for the "go" gage, and K_g' = Min. $E_S - 2h/3$ for the "not go" gage.

TABLE 9.—*Tolerances for W "go" and "not go" thread gages*

Threads per inch	Tolerance in lead[1]		Tolerance on half angle of thread		Tolerance on major or minor diameters			Tolerance on pitch diameter					Total cumulative tolerance[3]				
	To and including ½ in. diam	Above ½ in. diam			To and including ½ in. diam	Above ½ in. to 4 in. diam	Above 4 in. diam	To and including ½ in. diam	Above ½ in. to 1½ in. diam	Above 1½ in. to 4 in. diam	Above 4 in. to 8 in. diam	Above 8 in. to 12 in. diam[2]	To and including ½ in. diam	Above ½ in. to 1½ in. diam	Above 1½ in. to 4 in. diam	Above 4 in. to 8 in. diam	Above 8 in. to 12 in. diam[2]
1	2	3	4		5	6	7	8	9	10	11	12	13	14	15	16	17
	Inch ±	*Inch* ±	*Deg.* ±	*Min.*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
80.....	0.0001	0.00015	0	20	0.0003	0.0003	.....	0.0001	0.00015	.....	.....	.....	0.00038	0.00052	.....	.....	.....
72.....	.0001	.00015	0	20	.0003	.0003	.....	.0001	.00015	.....	.....	.....	.00039	.00053	.....	.....	.....
64.....	.0001	.00015	0	20	.0003	.0004	.....	.0001	.00015	.....	.....	.....	.00041	.00055	.....	.....	.....
56.....	.0001	.00015	0	20	.0003	.0004	.....	.0001	.00015	0.0002	.....	.....	.00043	.00057	0.00062	.....	.....
48.....	.0001	.00015	0	18	.0003	.0004	.....	.0001	.00015	.0002	.....	.....	.00044	.00057	.00062	.....	.....
44.....	.0001	.00015	0	15	.0003	.0004	.....	.0001	.00015	.0002	.....	.....	.00042	.00056	.00061	.....	.....
40.....	.0001	.00015	0	15	.0003	.0004	.....	.0001	.00015	.0002	.....	.....	.00044	.00057	.00062	.....	.....
36.....	.0001	.00015	0	12	.0003	.0004	.....	.0001	.00015	.0002	.....	.....	.00042	.00056	.00061	.....	.....
32.....	.0001	.00015	0	12	.0003	.0005	0.0007	.0001	.00015	.0002	0.00025	0.0003	.00044	.00057	.00062	0.00067	0.00072
28.....	.00015	.00015	0	8	.0005	.0005	.0007	.0001	.00015	.0002	.00025	.0003	.00048	.00053	.00058	.00063	.00068
24.....	.00015	.00015	0	8	.0005	.0005	.0007	.0001	.00015	.0002	.00025	.0003	.00051	.00056	.00061	.00066	.00071
20.....	.00015	.00015	0	8	.0005	.0005	.0007	.0001	.00015	.0002	.00025	.0003	.00053	.00058	.00063	.00068	.00073
18.....	.00015	.00015	0	8	.0005	.0005	.0007	.0001	.00015	.0002	.00025	.0003	.00055	.00060	.00065	.00070	.00075
16.....	.00015	.00015	0	8	.0006	.0006	.0009	.0001	.0002	.00025	.0003	.0004	.00058	.00068	.00073	.00078	.00088
14.....	.0002	.0002	0	6	.0006	.0006	.0009	.00015	.0002	.00025	.0003	.0004	.00068	.00073	.00078	.00083	.00093
13.....	.0002	.0002	0	6	.0006	.0006	.0009	.00015	.0002	.00025	.0003	.0004	.00070	.00075	.00080	.00085	.00095
12.....	.0002	.0002	0	6	.0006	.0006	.0009	.00015	.0002	.00025	.0003	.0004	.00071	.00076	.00081	.00086	.00096
11.....	.0002	.0002	0	6	.0006	.0006	.0009	.00015	.0002	.00025	.0003	.0004	.00073	.00078	.00083	.00088	.00098
10.....	.....	.00025	0	6	.....	.0006	.0009	.....	.0002	.00025	.0003	.0004	.....	.00089	.00094	.00099	.00109
9.....	.....	.00025	0	6	.....	.0007	.0011	.....	.0002	.00025	.0003	.0004	.....	.00092	.00097	.00102	.00112
8.....	.....	.00025	0	5	.....	.0007	.0011	.....	.0002	.00025	.0003	.0004	.....	.00091	.00096	.00101	.00111
7.....	.....	.0003	0	5	.....	.0007	.0011	.....	.0002	.00025	.0003	.0004	.....	.00103	.00108	.00113	.00123
6.....	.....	.0003	0	5	.....	.0008	.0013	.....	.0002	.00025	.0003	.0004	.....	.00108	.00113	.00118	.00128
5.....	.....	.0003	0	4	.....	.0008	.0013	.....	.....	.00025	.0003	.0004	.....	.....	.00112	.00117	.00127
4½.....	.....	.0003	0	4	.....	.0008	.0013	.....	.....	.00025	.0003	.0004	.....	.....	.00116	.00121	.00131
4.....	.....	.0003	0	4	.....	.0009	.0015	.....	.....	.00025	.0003	.0004	.....	.....	.00121	.00126	.00136

[1] Allowable variation in lead between any 2 threads not farther apart than the length of the standard gage, shown in CS8–41, omitting 1 full thread at each end of the gage.

[2] Above 12 inches the tolerance is directly proportional to the tolerance in this column, in the ratio of the diameter to 12 inches.

[3] The tolerance for 1 element, namely, pitch diameter, lead, or angle, as given above, may be exceeded provided that the errors in the other 2 elements are sufficiently small so that the total cumulative tolerance shown in columns 13 to 17 is not exceeded.

TABLE 10.—*Tolerances for X "go" and "not go" thread gages*

Threads per inch	Tolerance in lead[1]	Tolerance on half angle of thread	Tolerance on major or minor diameters		Tolerance on pitch diameter			
			To and including 4 in. diam	Above 4 in. diam	To and including 1½ in. diam	Above 1½ to 4 in. diam	Above 4 to 8 in. diam	Above 8 to 12 in. diam[2]
1	2	3	4	5	6	7	8	9
	Inch ±	*Deg. Min.* ±	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
80	0.0002	0 30	0.0003	.....	0.0002	.....	.....	.....
72	.0002	0 30	.0003	.....	.0002	.....	.....	.....
64	.0002	0 30	.0004	.....	.0002	.....	.....	.....
56	.0002	0 30	.0004	.....	.0002	0.0003	.....	.....
48	.0002	0 30	.0004	.....	.0002	.0003	.....	.....
44	.0002	0 20	.0004	.....	.0002	.0003	.....	.....
40	.0002	0 20	.0004	.....	.0002	.0003	.....	.....
36	.0002	0 20	.0004	.....	.0002	.0003	.....	.....
32	.0003	0 15	.0005	0.0007	.0003	.0004	0.0005	0.0006
28	.0003	0 15	.0005	.0007	.0003	.0004	.0005	.0006
24	.0003	0 15	.0005	.0007	.0003	.0004	.0005	.0006
20	.0003	0 15	.0005	.0007	.0003	.0004	.0005	.0006
18	.0003	0 10	.0005	.0007	.0003	.0004	.0005	.0006
16	.0003	0 10	.0006	.0009	.0003	.0004	.0006	.0008
14	.0003	0 10	.0006	.0009	.0003	.0004	.0006	.0008
13	.0003	0 10	.0006	.0009	.0003	.0004	.0006	.0008
12	.0003	0 10	.0006	.0009	.0003	.0004	.0006	.0008
11	.0003	0 10	.0006	.0009	.0003	.0004	.0006	.0008
10	.0003	0 10	.0006	.0009	.0003	.0004	.0006	.0008
9	.0003	0 10	.0007	.0011	.0003	.0004	.0006	.0008
8	.0004	0 5	.0007	.0011	.0004	.0005	.0006	.0008
7	.0004	0 5	.0007	.0011	.0004	.0005	.0006	.0008
6	.0004	0 5	.0008	.0013	.0004	.0005	.0006	.0008
5	.0004	0 5	.0008	.0013	.....	.0005	.0006	.0008
4½	.0004	0 5	.0008	.0013	.....	.0005	.0006	.0008
4	.0004	0 5	.0009	.0015	.....	.0005	.0006	.0008

[1]Allowable variation in lead between any two threads not farther apart than the length of the standard gage, shown in CS8-41, omitting one full thread at each end of the gage.

[2]Above 12 inches the tolerance is directly proportional to the tolerance in this column, in the ratio of the diameter to 12 inches.

TABLE 11.—*Tolerances for Y "go" thread gages*

Threads per inch	Tolerance in lead[1]	Tolerance on half angle of thread	Tolerance on major or minor diameters		Limits on pitch diameter							
			To and including 4 in. diam	Above 4 in. diam	To and including 1½ in. diam		Above 1½ in. to 4 in. diam		Above 4 in. to 8 in. diam		Above 8 in. to 12 in. diam[2]	
					From—	To—	From—	To—	From—	To—	From—	To—
1	2	3	4	5	6	7	8	9	10	11	12	13
	Inch ±	*Deg. Min.* ±	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
80	0.0002	0 45	0.0003	.....	0.0001	0.0003	.....	.....	.....	.....	.....	.....
72	.0002	0 45	.0003	.....	.0001	.0003	.....	.....	.....	.....	.....	.....
64	.0002	0 45	.0004	.....	.0001	.0004	.....	.....	.....	.....	.....	.....
56	.0002	0 45	.0004	.....	.0001	.0004	0.0001	0.0006	.....	.....	.....	.....
48	.0002	0 45	.0004	.....	.0001	.0004	.0001	.0006	.....	.....	.....	.....
44	.0002	0 30	.0004	.....	.0001	.0004	.0001	.0006	.....	.....	.....	.....
40	.0002	0 30	.0004	.....	.0001	.0004	.0001	.0006	.....	.....	.....	.....
36	.0002	0 30	.0004	.....	.0001	.0004	.0001	.0006	.....	.....	.....	.....
32	.0003	0 20	.0005	0.0007	.0001	.0004	.0001	.0006	0.0001	0.0008	0.0001	0.0010
28	.0003	0 20	.0005	.0007	.0002	.0005	.0002	.0007	.0002	.0009	.0002	.0011
24	.0003	0 20	.0005	.0007	.0002	.0005	.0002	.0007	.0002	.0009	.0002	.0011
20	.0003	0 20	.0005	.0007	.0002	.0005	.0002	.0007	.0002	.0009	.0002	..0011
18	.0003	0 15	.0005	.0007	.0002	.0005	.0002	.0007	.0002	.0009	.0002	.0011
16	.0003	0 15	.0006	.0009	.0002	.0006	.0002	.0008	.0002	.0010	.0002	.0011
14	.0003	0 15	.0006	.0009	.0002	.0006	.0002	.0008	.0002	.0010	.0002	.0012
13	.0003	0 15	.0006	.0009	.0002	.0006	.0002	.0008	.0002	.0010	.0002	.0012
12	.0003	0 10	.0006	.0009	.0002	.0006	.0002	.0008	.0002	.0010	.0002	.0012
11	.0003	0 10	.0006	.0009	.0002	.0006	.0002	.0008	.0002	.0010	.0002	.0012
10	.0003	0 10	.0006	.0009	.0002	.0006	.0002	.0008	.0002	.0010	.0002	.0012
9	.0003	0 10	.0007	.0011	.0002	.0007	.0002	.0009	.0002	.0011	.0002	.0013
8	.0004	0 5	.0007	.0011	.0002	.0007	.0002	.0009	.0002	.0011	.0002	.0013
7	.0004	0 5	.0007	.0011	.0002	.0007	.0002	.0009	.0002	.0011	.0002	.0013
6	.0004	0 5	.0008	.0013	.0003	.0008	.0003	.0010	.0003	.0012	.0003	.0014
5	.0004	0 5	.0008	.0013	.....	.....	.0003	.0010	.0003	.0012	.0003	.0014
4½	.0004	0 5	.0008	.0013	.....	.....	.0003	.0010	.0003	.0012	.0003	.0014
4	.0004	0 5	.0009	.0015	.....	.....	.0003	.0011	.0003	.0013	.0003	.0015

[1]Allowable variation in lead between any two threads not farther apart than the length of the standard gage, shown in CS8-41, omitting one full thread at each end of the gage.

[2]Above 12 inches the tolerance is directly proportional to the tolerance in this column, in the ratio of the diameter to 12 inches.

TABLE 12.—*Tolerances for plain gages*

Size range		XX	X	Y	Z
Above—	To and including—				
1	2	3	4	5	6
Inches	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*
0.029	0.825	0.00002	0.00004	0.00007	0.00010
.825	1.510	.00003	.00006	.00009	.00012
1.510	2.510	.00004	.00008	.00012	.00016
2.510	4.510	.00005	.00010	.00015	.00020
4.510	6.510	.000065	.00013	.00019	.00025
6.510	9.010	.00008	.00016	.00024	.00032
9.010	12.010	.00010	.00020	.00030	.00040

TABLE 13.—*Recommended uses for W, X, and Y, thread gages*

Class of fit	Full-form setting gages[1]	Truncated setting gages[1]	"Go" inspection gage	"Go" working gage	All "not go" inspection and working gages
1	2	3	4	5	6
Class 1 fit	X, table 10	W, table 9	Y, table 11	Y, table 11	X, table 10.
Class 2 fit	....do	....do	....do	....do	Do.
Class 3 fit	W or X, tables 9, 10	....do	X, table 10	X, table 10	Do.
Class 4 fit	W, table 9	....do	W, table 9	W, table 9	W, table 9.
Class 5 fit	....do	....do	....do	....do	Do.

[1]The pitch diameter limits are the same as on the thread ring gages for which the setting plugs are to be used. W or X tolerances on lead and thread angle apply as indicated.

4. PROCEDURE FOR DETERMINING THE CLEARANCE IN THREAD RING GAGES.—The root of thread of ring gages, particularly "not go" ring gages, frequently does not clear the maximum major diameter of the screw. To assist the gage maker and gage inspector, the recommended procedure for determining the clearance at root of thread of ring gages is given to supplement, or substitute for, the use of truncated setting plugs described in paragraphs 5 (b), p. 30, and 3, p. 34. For this purpose an optical examination of a sulfur-graphite, plaster-of-paris, copper-amalgam, or other suitable cast of the thread is made by means of a projection comparator, toolmaker's microscope, or universal measuring miscroscope. The actual magnification of the instrument as used must be known.

(*a*) *Methods of making sulfur-graphite casts.*—Sulfur-graphite casts are made from a thorough mixture of finely powdered graphite and crushed lump sulfur which is melted in a ladle until the sulfur is completely melted and becomes viscous. This mixture may be used repeatedly by crushing and remelting. The graphite should constitute about 7 percent of the mixture by weight, although in the practice of various users, the proportion varies from 4 to 20 percent. The graphite is added to eliminate reflections which would be produced by a plain sulfur cast, and to reduce the tendency to shrink upon cooling.

The casting mold may be formed by holding the ring gage between thin plates in the jaws of a vise, the top edge of the plate on one side being well below the thread axis. For small sizes of threads, a convenient arrangement is to use a taper mandrel that is provided with a lengthwise groove having smooth surfaces and an included angle of about 90°, into which the mixture is poured, and in which the cast is later mounted for examination. The bottom of the slot has a slight taper toward the axis at the small end. A square metal stop clamped in the groove serves as a wall in casting. The mandrel is also useful in making copper-amalgam casts, in which case the casting mixture is pressed in.

The casting mixture is poured into the mold when the temperature is from 260° to 266° F, and allowed to solidify with slow

cooling. The cast may be marked with an identification number with a steel stylus. Sulfur-graphite casts warp considerably after a few hours.

(*b*) *Method of making plaster-of-paris casts.*—A plaster-of-paris cast is usually made to determine errors in thread angle, and this cast can usually be used to determine clearance. Such a cast is made by mixing 5 parts (28 g, or 1 oz) of a good grade of dental plaster-of-paris with from 4 to 5 (26 ml) parts by weight of potassium-bichromate solution made by dissolving 40 g in 1 liter of water. The potassium bichromate inhibits rusting of the gage. This mixture is applied to the threads inside a mold which may be fashioned from cardboard or a strip of copper, with modeling clay pressed into the threads along the outside bottom edges of the mold. It should be allowed to harden completely before removal. Plaster-of-paris casts have less shrinkage than sulfur-graphite, but do not retain dimensions over extended periods of time. They are difficult to remove from rough threads without damage.

(*c*) *Determining clearance of "go" thread ring gages.*—The flat at crest of the *maximum* screw is one-eighth of the pitch, therefore, if the root of thread of the "go" ring is relieved to a width of one-eighth the pitch, the ring threads are clear. If the roots of the "go" ring gage threads are not relieved, they must be sharp enough to clear a flat of one-eighth the pitch. The flanks of the thread should be straight to the point where the ⅛-pitch flat will make contact with the flanks of the thread. The width of flat on the chart, or template, used should be one-eighth of the pitch times the magnification of the comparator.

(*d*) *Determining clearance of "not go" thread ring gages.*—The flat at the crest of a screw with maximum major diameter and minimum pitch diameter is determined by the formula:

$$\text{Flat} = \frac{P}{2} - h' \tan 30^\circ = \frac{P}{2} - 0.57735h'$$

for American National form of thread, where, h' = max major diameter-min pitch diameter.

If the "not go" ring gage has a relief of ¼ pitch, as recommended, it is necessary to determine whether or not the relief is deep enough. To do this, make a chart, or template, representing a 60° thread with a flat at crest equal to the flat, as determined by the above formula times the magnification of the comparator. This chart, or template, should fit the image of thread and contact the flanks of the thread image without contacting in the relief. If ring threads are not relieved, they must be sharp enough to permit the chart, or template, to contact on the flanks of the image rather than in the root.

5. Sharp End Threads.—The partial thread at the entering end of both the "go" and the "not go" thread plug gages shall either be removed to the point where the full thread begins, or the end of the gage shall be chamfered to a 60° chamfer angle.

6. Chip Grooves in "Go" Thread Plug Gages.—Each "go" thread plug gage, except in sizes smaller than No. 3, shall be provided with a chip groove, which is a slot cut in the threaded portion at the entering end parallel to the axis, in accordance with the following specifications:

(*a*) *Length of groove.*—The length of the groove shall be from 3 to 4 threads for 10 threads per inch and finer, and from 2 to 3 threads on coarser pitches.

(*b*) *Depth of groove.*—The depth of the groove shall be such that it extends below the sharp V thread from 0.010 to 0.020 inch.

(*c*) *Width of groove.*—The width of the groove shall be as follows:

Nominal range, inclusive	Decimal range		Width of groove	
	Above—	To and including—	Basic width	Tolerance
	Inches	*Inches*	*Inch*	*Inch* ±
Nos. 3 to 6.....	0.090	0.150	0.020	0.005
No. 7 to ⅜.....	.151	.385	1/32	.005
7/16 to 2.....	.386	2.010	1/16	.005
Over 2.....	2.011	.....	3/32	.005

(*d*) *Position of groove.*—The groove shall be located circumferentially at the start of the full thread.

7. Thread Snap Gages.—Thread snap gages are generally adjustable and have contact points consisting of cone-pointed anvils, wedge-shaped prisms with rounded edges, serrated or grooved plates, or grooved or threaded cylinders adjustably mounted and suitably spaced in a U-shaped frame. These gages are used to some extent in gaging external threads and have the advantages that work may be inspected with great rapidity by the single motion of passing it between the anvils of the gage and given a visual examination for clearance as well as a tactile inspection. The positions of the anvils are set to a threaded setting gage, and the anvils are then clamped in position and sealed. Thread snap gages are to be preferred as "not go" gages.

The cone-pointed snap gage usually has a single point on each side of the frame, and is an effective "not go" gage. It does not, however, fully meet the requirements for a "go" gage, as it does not check the lead, and therefore, must be supplemented with some type of indicating gage to check the lead when used for checking pitch diameter, angle, and thread form. Also, as it checks only a single diameter at a time, the "go" snap gage must be tried at a series of points to determine whether the maximum pitch diameter of an external thread is within the tolerance. When provided with three contact points, two on one side spaced an integral number of threads apart and one on the other, such a gage checks the lead for progressive, but not always for local or periodic lead errors, and, thus, it more nearly fulfills the requirements for a "go" thread gage. This type or other types of short engagement are suitable for product of classes 4 and 5, provided that an independent inspection of the lead is made.

Thread snap gages having multiple toothed contact points, that is, toothed blades, serrated or grooved plates, or grooved or threaded cylinders, are made in a variety of forms, either as separate or combined "go" and "not go" gages. The fit of a screw in such a gage is affected by variations in pitch diameter, lead, and angle of the screw, and the gage accordingly may be used as a "go" gage for the less accurate classes of work, such as classes 1 and 2, and, if well designed and accurately made, also for classes 3, 4, and 5.

8. Tolerances for Plain Gages.—For plain plug gages, plain ring gages, and plain adjustable snap gages required for measuring diameters of screw-thread work, the gage tolerances specified in table 12 may be used. These tolerances are designated XX, X, Y, and Z. Y plain gages are recommended for working and inspection gages for gaging major and minor diameters of all classes of threaded product. Tables of limiting dimensions for Y gages, for the standard thread series, are included in section IV.

9. Marking of Gages.—Each gage shall be plainly and permanently marked, for identification, with the diameter, pitch, thread series, and class of fit.

For example: A 1-inch, 8-pitch, gage of the American National coarse-thread series, class 2 fit, shall be marked 1"—8NC—2.

A 1-inch, 14-pitch gage of the American National fine-thread series, class 3 fit, shall be marked 1"—14NF—3.

(c) Recommended Gage Practice

1. Uses of W, X, and Y Thread Gages.—There are given in table 13 the recommended uses for the foregoing thread plug and ring gages.

2. Gaging Class 5 Product.—The relatively close limits on pitch diameter specified for class 5 fit for threaded studs, necessitate careful and accurate gaging of both the stud and tapped hole, particularly since the actual measurements obtained depend somewhat upon the methods of gaging used.

Considering first the case of minimum interference: The minimum stud and maximum hole are selected by means of "not go" gages. With the usual or recommended forms of "not go" gages, the presence of lead errors does not affect the gaging, if the gage is not allowed to enter the work more than 1½ turns. It has been shown by the experimental data obtained that this is a desirable condition, as the presence of a slight difference in lead between stud and hole is an

advantage, especially with minimum pitch diameter interference. It is important, however, as with the other classes of fit, that the "not go" gage should check primarily the pitch diameter, for upon this the minimum tightness of a stud fit depends, assuming that the correct thread form and smoothness of thread surface are maintained.

In the case of maximum interference the maximum stud and minimum hole are selected by means of "go" gages, and these may or may not be the usual types of threaded plugs and rings. Plug and ring gages control pitch diameter, lead, thread angle, maximum minor diameter of stud, and minimum major diameter of hole. The minimum minor diameter of the hole being considerably above basic, it is not controlled by the "go" threaded plug gage, and as it has been shown that a certain minimum clearance at minor diameter must be maintained, it is very important that the hole should be gaged further by means of a "go" plain plug gage. Gaging the tapped hole by means of a "not go" plain plug gage is also desirable, but not strictly necessary.

Gaging of the major diameter of the stud thread is not essential; this element may be controlled by the size of stock. Some means of controlling the minimum minor diameter of the stud is, however, very desirable, particularly on studs of the smaller sizes, because the shearing strength of the stud depends upon this element. For this purpose the projection comparator is very useful, but inspection of the cutting tool to assure a width of flat at the root of the thread not less than $\frac{1}{8} \times p$ is sufficient.

The use of thread micrometers or "go" thread snap gages of short engagement for checking the pitch diameter of the stud is good practice provided that the thread form is ascertained by optical inspection. Gaging for lead errors is not essential provided that the lead of the threading tools is maintained within the usual limits of good commercial practice.

If the tap (ground thread tap) is a close fit in the hole after tapping—that is, if the tap cannot be screwed easily (without the use of a wrench) through the hole after tapping—it may be assumed that the pitch diameter of the hole is very nearly the same as that of the tap.

3. Acceptability of Product.—It is suggested that, in case of question between the manufacturer and purchaser of threaded products in regard to their size, if the manufacturer produces limit gages which do not measure outside of the specified limits for the threaded components and which pass the parts in question, they be accepted as meeting the specifications for size. In case the dimensions of the gages are questioned, their sizes shall be determined by a disinterested third party, preferably the National Bureau of Standards at Washington, 25, D. C., which maintains a department for this service.

4. SIZES OF TAP DRILLS (NOT MANDATORY)

The essential requirement of a tap drill is that the hole produced by it shall be such that, when tapped with a screw thread, the minor diameter of the tapped hole shall be within the specified limits. It should be noted that the minor diameters of the tapped holes are the same for classes 1 to 4, inclusive.

If the drill is too large the minor diameter of the tapped hole will also be too large, and the thread in the nut will be too shallow, that is, too small a percentage of a full thread. As an extreme case, the threads in the tapped hole will engage only the tops of the threads on a screw of correct size, and under stress the threads of the screw will strip and the full strength of the fastening will not be developed.

If, on the other hand, the tap drill is too small, the tap will be forced to cut a thread of full depth, and in the extreme case to act as a reamer also. This will result in excessive power consumption and tap breakage, and will also make the minor diameter of the tapped hole dependent upon the minor diameter of the tap. This is undesirable, since the minor diameter of the tap is not, in general, held to the same close limits as the other tap elements, and as a

result the minor diameter of a hole tapped under these conditions may be in error even though the tap is otherwise correct.

It is a well-known fact that the size of the hole produced by a tap drill depends to some extent upon the method of grinding the drill, the material drilled, the lubricant used, and the alinement, speed, and feed of operation. This being true, it is apparent that fixing the diameter of the tap drill does not completely fix the diameter of the drilled hole. The most that can be accomplished is to fix the drill diameters between certain limits and to depend upon correct grinding, lubrication, and operation to keep the diameter of the holes within prescribed limits.

There are listed in tables in section IV for each thread series, all drill sizes regularly carried in stock, both English and metric, which fall between the limiting dimentions of the minor diameter of the threaded hole. There are several thread sizes, however, for which there are no stock drills falling within the minor diameter limits, and for these the nearest drills outside of the maximum and minimum limits are listed in italics. If the material to be tapped is such that there is considerable "spin-up" on minor diameter during tapping, then the larger of the two drills listed for a given size should be selected. If the material is cast iron or other material with little or no "spin-up", then the smaller of the two drills listed should be chosen. It will usually cut oversize by a sufficient amount to bring the minor diameter above the minimum limit.

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SECTION IV. AMERICAN NATIONAL THREAD SERIES[12]

1. GENERAL

Complete dimensional data are presented in this section for six standard thread series, namely, the American National coarse, fine, extra-fine, 8-pitch, 12-pitch, and 16-pitch thread series. These data include the dimensional limits of the product, dimensional limits of thread and plain gages, and as nonmandatory but useful information, tap-drill sizes. The application of each of the thread series is stated under the corresponding heading. The specifications in section III relative to form of thread, classification and tolerances, and gages are applicable to these thread series.

In order to present the scope of these thread series and to facilitate comparison, these series together with basic data pertaining thereto are summarized in tables 14 and 15.

The aeronautic screw thread series, presented in table 52, comprises a selection from among the sizes of these six standard thread series for use in aircraft and aeronautical equipment.

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[12] These thread series have been adopted by the American Standards Association and published in ASA B1.1-1935, Screw Threads. The limiting dimensions of gages are only in partial agreement with ASA B1.2-1941. Screw Thread Gages and Gaging. (See footnote 8, p. 29.) Tap drill sizes are in agreement with ASA B5.12-1940, Twist Drills, Straight Shank. These standards are published by the A.S.M.E., 29 West 39th St., New York, N. Y.

TABLE 14.—*American National coarse, fine, and extra-fine thread series*

Sizes	Basic major diameter, D	Metric equivalent of major diameter	Coarse-thread series					Fine-thread series					Extra-fine-thread series				
			Threads per inch, n	Basic pitch diameter, E	Basic minor diameter, K	Helix angle at basic pitch diameter, s	Basic area of section at root of thread, $\frac{\pi K^2}{4}$	Threads per inch, n	Basic pitch diameter, E	Basic minor diameter, K	Helix angle at basic pitch diameter, s	Basic area of section at root of thread, $\frac{\pi K^2}{4}$	Threads per inch	Basic pitch diameter, E	Basic minor diameter, K	Helix angle at basic pitch diameter, s	Basic area of section at root of thread, $\frac{\pi K^2}{4}$
	Inches	*mm*		*Inches*	*Inches*	*Deg. Min.*	*Square inches*		*Inches*	*Inches*	*Deg. Min.*	*Square inches*		*Inches*	*Inches*	*Deg. Min.*	*Square inches*
0	0.060	1.524	.....	.....	.....	.....	.....	80	0.0519	0.0438	4 23	0.0015	.....	.....	.....	.....	.....
1	0.073	1.854	64	0.0629	0.0527	4 31	0.0022	72	.0640	.0550	3 57	.0024	.....	.....	.....	.....	.....
2	.086	2.184	56	.0744	.0628	4 22	.0031	64	.0759	.0657	3 45	.0034	.....	.....	.....	.....	.....
3	.099	2.515	48	.0855	.0719	4 26	.0041	56	.0874	.0758	3 43	.0045	.....	.....	.....	.....	.....
4	.112	2.845	40	.0958	.0795	4 45	.0050	48	.0985	.0849	3 51	.0057	.....	.....	.....	.....	.....
5	.125	3.175	40	.1088	.0925	4 11	.0067	44	.1102	.0955	3 45	.0072	.....	.....	.....	.....	.....
6	.138	3.505	32	.1177	.0974	4 50	.0075	40	.1218	.1055	3 44	.0087	.....	.....	.....	.....	.....
8	.164	4.166	32	.1437	.1234	3 58	.0120	36	.1460	.1279	3 28	.0128	.....	.....	.....	.....	.....
10	.190	4.826	24	.1629	.1359	4 39	.0145	32	.1697	.1494	3 21	.0175	.....	.....	.....	.....	.....
12	.216	5.486	24	.1889	.1619	4 1	.0206	28	.1928	.1696	3 22	.0226	.....	.....	.....	.....	.....
1/4	.2500	6.350	20	.2175	.1850	4 11	.0269	28	.2268	.2036	2 52	.0326	32	0.2297	0.2094	2 29	0.0344
5/16	.3125	7.938	18	.2764	.2403	3 40	.0454	24	.2854	.2584	2 40	.0524	32	.2922	.2719	1 57	.0581
3/8	.3750	9.525	16	.3341	.2938	3 24	.0678	24	.3479	.3209	2 11	.0809	32	.3547	.3344	1 36	.0878
7/16	.4375	11.113	14	.3911	.3417	3 20	.0933	20	.4050	.3725	2 15	.1090	28	.4143	.3911	1 34	.1201
1/2	.5000	12.700	13	.4500	.4001	3 7	.1257	20	.4675	.4350	1 57	.1486	28	.4768	.4536	1 22	.1616
9/16	.5625	14.288	12	.5084	.4542	2 59	.1620	18	.5261	.4903	1 55	.1888	24	.5354	.5084	1 25	.2030
5/8	.6250	15.875	11	.5660	.5069	2 56	.2018	18	.5889	.5528	1 43	.2400	24	.5979	.5709	1 16	.2560
11/16	.6875	17.463	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	24	.6604	.6334	1 9	.3151
3/4	.7500	19.050	1	.6850	.6201	2 40	.3020	16	.7094	.6688	1 36	.3513	20	.7175	.6850	1 16	.3685
13/16	.8125	20.638	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	20	.7800	.7475	1 10	.4388
7/8	.8750	22.225	9	.8028	.7307	2 31	.4193	14	.8286	.7822	1 34	.4805	20	.8425	.8100	1 5	.5153
15/16	.9375	23.813	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	20	.9050	.8725	1 0	.5979
1	1.0000	25.400	8	.9188	.8376	2 29	.5510	14	.9536	.9072	1 22	.6464	20	.9675	.9350	0 57	.6866
1 1/16	1.0625	26.988	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18	1.0264	.9903	0 59	.7702
1 1/8	1.1250	28.575	7	1.0322	.9394	2 31	.6931	12	1.0709	1.0167	1 25	.8118	18	1.0889	1.0528	0 56	.8705
1 3/16	1.1875	30.163	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18	1.1514	1.1153	0 53	.9770
1 1/4	1.2500	31.750	7	1.1572	1.0644	2 15	.8898	12	1.1959	1.1417	1 16	1.0237	18	1.2139	1.1778	0 50	1.0895
1 5/16	1.3125	33.338	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18	1.2764	1.2403	0 48	1.2082
1 3/8	1.3750	34.925	6	1.2667	1.1585	2 24	1.0541	12	1.3209	1.2667	1 9	1.2602	18	1.3389	1.3028	0 45	1.3330
1 7/16	1.4375	36.513	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18	1.4014	1.3653	0 43	1.4640
1 1/2	1.5000	38.100	6	1.3917	1.2835	2 11	1.2938	12	1.4459	1.3917	1 3	1.5212	18	1.4639	1.4278	0 42	1.6011
1 9/16	1.5625	39.688	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18	1.5264	1.4903	0 40	1.7444
1 5/8	1.6250	41.275	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18	1.5889	1.5528	0 38	1.8937
1 11/16	1.6875	42.863	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18	1.6514	1.6153	0 37	2.0493
1 3/4	1.7500	44.450	5	1.6201	1.4902	2 15	1.7441	.....	.....	.....	.....	.....	16	1.7094	1.6688	0 40	2.1873
2	2.0000	50.800	4 1/2	1.8557	1.7113	2 11	2.3001	.....	.....	.....	.....	.....	16	1.9594	1.9188	0 35	2.8917
2 1/4	2.2500	57.150	4 1/2	2.1057	1.9613	1 55	3.0212	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2 1/2	2.5000	63.500	4	2.3376	2.1752	1 57	3.7161	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2 3/4	2.7500	69.850	4	2.5876	2.4252	1 46	4.6194	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3	3.0000	76.200	4	2.8376	2.6752	1 36	5.6209	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3 1/4	3.2500	82.550	4	3.0876	2.9252	1 29	6.7205	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3 1/2	3.5000	88.900	4	3.3376	3.1752	1 22	7.9183	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3 3/4	3.7500	95.250	4	3.5876	3.4252	1 16	9.2143	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	4.0000	101.600	4	3.8376	3.6752	1 11	10.6084	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE 15.—*American National 8-pitch, 12-pitch, and 16-pitch thread series*

Sizes	Basic major diameter, D	Metric equivalent of major diameter	8-pitch thread series				12-pitch thread series				16-pitch thread series			
			Basic pitch diameter, E	Basic minor diameter, K	Helix angle at basic pitch diameter, s	Basic area of section at root of thread, $\frac{\pi K^2}{4}$	Basic pitch diameter, E	Basic minor diameter, K	Helix angle at basic pitch diameter, s	Basic area of section at root of thread, $\frac{\pi K^2}{4}$	Basic pitch diameter, E	Basic minor diameter, K	Helix angle at basic pitch diameter, s	Basic area of section at root of thread, $\frac{\pi K^2}{4}$
Inches	*Inches*	*mm*	*Inches*	*Inches*	*Deg. Min.*	*Sq.inches*	*Inches*	*Inches*	*Deg. Min.*	*Sq.inches*	*Inches*	*Inches*	*Deg. Min.*	*Sq.inches*
1/2	0.5000	12.700	.....	.....	.....	.....	0.4459	0.3917	3 24	0.1205	.....	.....	.....	.....
9/16	.5625	14.288	.....	.....	.....	.....	.5084	.4542	2 59	.1620	.....	.....	.....	.....
5/8	.6250	15.875	.....	.....	.....	.....	.5709	.5167	2 40	.2097	.....	.....	.....	.....
11/16	.6875	17.463	.....	.....	.....	.....	.6334	.5792	2 24	.2635	.....	.....	.....	.....
3/4	.7500	19.050	.....	.....	.....	.....	.6959	.6417	2 11	.3234	0.7094	0.6688	1 36	0.3513
13/16	.8125	20.638	.....	.....	.....	.....	.7584	.7042	2 0	.3895	.7719	.7313	1 29	.4200
7/8	.8750	22.225	.....	.....	.....	.....	.8209	.7667	1 51	.4617	.8344	.7938	1 22	.4949
15/16	.9375	23.813	.....	.....	.....	.....	.8834	.8292	1 43	.5400	.8969	.8563	1 16	.5759
1	1.0000	25.400	0.9188	0.8376	2 29	0.5510	.9459	.8917	1 36	.6245	.9594	.9188	1 11	.6630
1 1/16	1.0625	26.988	.....	.....	.....	.....	1.0084	.9542	1 30	.7151	1.0219	.9813	1 7	.7563
1 1/8	1.1250	28.575	1.0438	.9626	2 11	.7277	1.0709	1.0167	1 25	.8118	1.0844	1.0438	1 3	.8557
1 3/16	1.1875	30.163	.....	.....	.....	.....	1.1334	1.0792	1 20	.9147	1.1469	1.1063	1 0	.9612
1 1/4	1.2500	31.750	1.1688	1.0876	1 57	.9290	1.1959	1.1417	1 16	1.0237	1.2094	1.1688	0 57	1.0729
1 5/16	1.3125	33.338	.....	.....	.....	.....	1.2584	1.2042	1 12	1.1389	1.2719	1.2313	0 54	1.1907
1 3/8	1.3750	34.925	1.2938	1.2126	1 46	1.1548	1.3209	1.2667	1 9	1.2602	1.3344	1.2938	0 51	1.3147
1 7/16	1.4375	36.513	.....	.....	.....	.....	1.3834	1.3292	1 6	1.3876	1.3969	1.3563	0 49	1.4448
1 1/2	1.5000	38.100	1.4188	1.3376	1 36	1.4052	1.4459	1.3917	1 3	1.5212	1.4594	1.4188	0 47	1.5810
1 9/16	1.5625	39.688	.....	.....	.....	.....	.....	.....	.....	.....	1.5219	1.4813	0 45	1.7234
1 5/8	1.6250	41.275	1.5438	1.4626	1 29	1.6801	1.5709	1.5167	0 58	1.8067	1.5844	1.5438	0 43	1.8719
1 11/16	1.6875	42.863	.....	.....	.....	.....	.....	.....	.....	.....	1.6469	1.6063	0 42	2.0265
1 3/4	1.7500	44.450	1.6688	1.5876	1 22	1.9796	1.6959	1.6417	0 54	2.1168	1.7094	1.6688	0 40	2.1873
1 13/16	1.8125	46.038	.....	.....	.....	.....	.....	.....	.....	.....	1.7719	1.7313	0 39	2.3542
1 7/8	1.8750	47.625	1.7938	1.7126	1 16	2.3036	1.8209	1.7667	0 50	2.4514	1.8344	1.7938	0 37	2.5272
1 15/16	1.9375	49.213	.....	.....	.....	.....	.....	.....	.....	.....	1.8969	1.8563	0 36	2.7064
2	2.0000	50.800	1.9188	1.8376	1 11	2.6521	1.9459	1.8917	0 47	2.8106	1.9594	1.9188	0 35	2.8917
2 1/16	2.0625	52.388	.....	.....	.....	.....	.....	.....	.....	.....	2.0219	1.9813	0 34	3.0831
2 1/8	2.1250	53.975	2.0438	1.9626	1 7	3.0252	2.0709	2.0167	0 44	3.1943	2.0844	2.0438	0 33	3.2807
2 3/16	2.1875	55.563	.....	.....	.....	.....	.....	.....	.....	.....	2.1469	2.1063	0 32	3.4844
2 1/4	2.2500	57.150	2.1688	2.0876	1 3	3.4228	2.1959	2.1417	0 42	3.6025	2.2094	2.1688	0 31	3.6943
2 5/16	2.3125	58.738	.....	.....	.....	.....	.....	.....	.....	.....	2.2719	2.2313	0 30	3.9103
2 3/8	2.3750	60.325	.....	.....	.....	.....	2.3209	2.2667	0 39	4.0353	2.3344	2.2938	0 29	4.1324
2 7/16	2.4375	61.913	.....	.....	.....	.....	.....	.....	.....	.....	2.3969	2.3563	0 29	4.3606
2 1/2	2.5000	63.500	2.4188	2.3376	0 57	4.2917	2.4459	2.3917	0 37	4.4927	2.4594	2.4188	0 28	4.5950
2 5/8	2.6250	66.675	.....	.....	.....	.....	2.5709	2.5167	0 35	4.9745	2.5844	2.5438	0 26	5.0822
2 3/4	2.7500	69.850	2.6688	2.5876	0 51	5.2588	2.6959	2.6417	0 34	5.4810	2.7094	2.6688	0 25	5.5940
2 7/8	2.8750	73.025	.....	.....	.....	.....	2.8209	2.7667	0 32	6.0119	2.8344	2.7938	0 24	6.1303
3	3.0000	76.200	2.9188	2.8376	0 47	6.3240	2.9459	2.8917	0 31	6.5674	2.9594	2.9188	0 23	6.6911
3 1/8	3.1250	79.375	.....	.....	.....	.....	3.0709	3.0167	0 30	7.1475	3.0844	3.0438	0 22	7.2765
3 1/4	3.2500	82.550	3.1688	3.0876	0 43	7.4874	3.1959	3.1417	0 29	7.7521	3.2094	3.1688	0 21	7.8864
3 3/8	3.3750	85.725	.....	.....	.....	.....	3.3209	3.2667	0 27	8.3812	3.3344	3.2938	0 21	8.5209
3 1/2	3.5000	88.900	3.4188	3.3376	0 40	8.7490	3.4459	3.3917	0 26	9.0349	3.4594	3.4188	0 20	9.1799
3 5/8	3.6250	92.075	.....	.....	.....	.....	3.5709	3.5167	0 26	9.7132	3.5844	3.5438	0 19	9.8634
3 3/4	3.7500	95.250	3.6688	3.5876	0 37	10.1088	3.6959	3.6417	0 25	10.4159	3.7094	3.6688	0 18	10.5715
3 7/8	3.8750	98.425	.....	.....	.....	.....	3.8209	3.7667	0 24	11.1433	3.8344	3.7938	0 18	11.3042
4	4.0000	101.600	3.9188	3.8376	0 35	11.5667	3.9459	3.8917	0 23	11.8951	3.9594	3.9188	0 17	12.0614
4 1/4	4.2500	107.950	4.1688	4.0876	0 33	13.1228	4.1959	4.1417	0 22	13.4725	.....	.....	.....	.....
4 1/2	4.5000	114.300	4.4188	4.3376	0 31	14.7771	4.4459	4.3917	0 21	15.1480	.....	.....	.....	.....
4 3/4	4.7500	120.650	4.6688	4.5876	0 29	16.5295	4.6959	4.6417	0 19	16.9217	.....	.....	.....	.....
5	5.0000	127.000	4.9188	4.8376	0 28	18.3802	4.9459	4.8917	0 18	18.7936	.....	.....	.....	.....
5 1/4	5.2500	133.350	5.1688	5.0876	0 26	20.3290	5.1959	5.1417	0 18	20.7636	.....	.....	.....	.....
5 1/2	5.5000	139.700	5.4188	5.3376	0 25	22.3760	5.4459	5.3917	0 17	22.8319	.....	.....	.....	.....
5 3/4	5.7500	146.050	5.6688	5.5876	0 24	24.5211	5.6959	5.6417	0 16	24.9983	.....	.....	.....	.....
6	6.0000	152.400	5.9188	5.8376	0 23	26.7645	5.9459	5.8917	0 15	27.2628	.....	.....	.....	.....

2. AMERICAN NATIONAL COARSE-THREAD SERIES

The American National coarse-thread series, as specified in table 14, is recommended for general use in engineering work, in machine construction where conditions are favorable to the use of bolts, screws, and other threaded components where quick and easy assembly of the parts is desired, and for all work where conditions do not require the use of fine-pitch threads. This series is composed of the "United States standard" threads, supplemented in the sizes below one-fourth inch by sizes taken from the standard established by the American Society of Mechanical Engineers (A.S.M.E.).

Threads of the American National coarse-thread series are designated by the symbol "NC."

Examples:

To specify a threaded part 1 inch diameter, 8 threads per inch, class 1 fit, mark..... *1"—8NC—1*

Threaded part 1 inch diameter, 8 threads per inch, class 2 fit, left hand, mark..... *1"—8NC—2LH*

The limiting dimensions of the American National coarse-thread series, corresponding to the tolerances and allowances determining classes 1, 2, 3, 4, and 5 fits, as established in section III, are given in tables 16 and 17. The limiting dimensions given for classes 4 and 5 do not include the complete range of sizes of this thread series.

Limiting dimensions of gages of the several classifications for this thread series are given in tables 18, 19, 20, 21, and 22. There are given in table 23, as useful information (not mandatory), all drills regularly carried in stock, both English and metric, which fall between the limiting dimensions of the minor diameter of the threaded holes of this thread series.

TABLE 16.—*Limiting dimensions and tolerances, classes 1, 2, 3, and 4 fits, American National coarse-thread series*

Dimensions and tolerances	Machine screw number or nominal size															
	1	2	3	4	5	6	8	10	12	¼	5/16	3/8	7/16	½	9/16	5/8
	Threads per inch															
	64	56	48	40	40	32	32	24	24	20	18	16	14	13	12	11
BOLTS AND SCREWS	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
Class 1, major diameter — Max...	0.0723	0.0852	0.0981	0.1110	0.1240	0.1369	0.1629	0.1887	0.2147	0.2485	0.3109	0.3732	0.4354	0.4978	0.5601	0.6224
Class 1, major diameter — Min...	.0671	.0796	.0919	.1042	.1172	.1293	.1553	.1795	.2055	.2383	.2995	.3606	.4214	.4830	.5443	.6054
Class 1, major diameter — Tol...	.0052	.0056	.0062	.0068	.0068	.0076	.0076	.0092	.0092	.0102	.0114	.0126	.0140	.0148	.0158	.0170
Classes 2, 3, and 4, major diameter — Max...	.0730	.0860	.0990	.1120	.1250	.1380	.1640	.1900	.2160	.2500	.3125	.3750	.4375	.5000	.5625	.6250
Classes 2, 3, and 4, major diameter — Min...	.0592	.0820	.0946	.1072	.1202	.1326	.1586	.1834	.2094	.2428	.3043	.3660	.4277	.4896	.5513	.6132
Classes 2, 3, and 4, major diameter — Tol...	.0038	.0040	.0044	.0048	.0048	.0054	.0054	.0066	.0066	.0072	.0082	.0090	.0098	.0104	.0112	.0118
Class 2, major diameter (threaded parts of unfinished, hot-rolled material) — Max...	.0730	.0860	.0990	.1120	.1250	.1380	.1640	.1900	.2160	.2500	.3125	.3750	.4375	.5000	.5625	.6250
Class 2, major diameter (threaded parts of unfinished, hot-rolled material) — Min...	.0678	.0804	.0928	.1052	.1182	.1304	.1564	.1808	.2068	.2398	.3011	.3624	.4235	.4852	.5467	.6080
Class 2, major diameter (threaded parts of unfinished, hot-rolled material) — Tol...	.0052	.0056	.0062	.0068	.0068	.0076	.0076	.0092	.0092	.0102	.0114	.0126	.0140	.0148	.0158	.0170
Class 1, minor diameter — Max[1]..	.0531	.0633	.0725	.0803	.0933	.0986	.1246	.1376	.1636	.1872	.2427	.2965	.3478	.4034	.4579	.5109
Classes 2, 3, and 4, minor diameter — Max[1]..	.0538	.0641	.0734	.0813	.0943	.0997	.1257	.1389	.1649	.1887	.2443	.2983	.3499	.4056	.4603	.5135
Class 1, pitch diameter — Max[3]..	.0622	.0736	.0846	.0948	.1078	.1166	.1426	.1616	.1876	.2160	.2748	.3326	.3890	.4478	.5060	.5634
Class 1, pitch diameter — Min...	.0596	.0708	.0815	.0914	.1044	.1128	.1388	.1570	.1830	.2109	.2691	.3263	.3820	.4404	.4981	.5549
Class 1, pitch diameter — Tol...	.0026	.0028	.0031	.0034	.0034	.0038	.0038	.0046	.0046	.0051	.0057	.0063	.0070	.0074	.0079	.0085
Class 2, pitch diameter — Max[3]..	.0629	.0744	.0855	.0958	.1088	.1177	.1437	.1629	.1889	.2175	.2764	.3344	.3911	.4500	.5084	.5660
Class 2, pitch diameter — Min...	.0610	.0724	.0833	.0934	.1064	.1150	.1410	.1596	.1856	.2139	.2723	.3299	.3862	.4448	.5028	.5601
Class 2, pitch diameter — Tol...	.0019	.0020	.0022	.0024	.0024	.0027	.0027	.0033	.0033	.0036	.0041	.0045	.0049	.0052	.0056	.0059
Class 3, pitch diameter — Max[3]..	.0629	.0744	.0855	.0958	.1088	.1177	.1437	.1629	.1889	.2175	.2764	.3344	.3911	.4500	.5084	.5660
Class 3, pitch diameter — Min...	.0615	.0729	.0839	.0941	.1071	.1158	.1418	.1605	.1865	.2149	.2734	.3312	.3875	.4463	.5044	.5616
Class 3, pitch diameter — Tol...	.0014	.0015	.0016	.0017	.0017	.0019	.0019	.0024	.0024	.0026	.0030	.0032	.0036	.0037	.0040	.0042
Class 4, pitch diameter — Max[3]..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2178	.2767	.3348	.3915	.4504	.5089	.5665
Class 4, pitch diameter — Min...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2165	.2752	.3332	.3897	.4485	.5069	.5644
Class 4, pitch diameter — Tol...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.0013	.0015	.0016	.0018	.0019	.0020	.0021
NUTS AND TAPPED HOLES																
Classes 1, 2, 3, and 4, major diameter.. Min[2]..	.0730	.0860	.0990	.1120	.1250	.1380	.1640	.1900	.2160	.2500	.3125	.3750	.4375	.5000	.5625	.6250
Classes 1, 2, 3, and 4, minor diameter.. Min...	.0561	.0667	.0764	.0849	.0979	.1042	.1302	.1449	.1709	.1959	.2524	.3073	.3602	.4167	.4723	.5266
Classes 1, 2, 3, and 4, minor diameter.. Max...	.0623	.0737	.0841	.0938	.1062	.1145	.1384	.1559	.1801	.2060	.2630	.3184	.3721	.4290	.4850	.5397
Classes 1, 2, 3, and 4, minor diameter.. Tol...	.0062	.0070	.0077	.0089	.0083	.0103	.0082	.0110	.0092	.0101	.0106	.0111	.0119	.0123	.0127	.0131
Classes 1, 2, 3, and 4, pitch diameter.. Min[3]..	.0629	.0744	.0855	.0958	.1088	.1177	.1437	.1629	.1889	.2175	.2764	.3344	.3911	.4500	.5084	.5660
Class 1, pitch diameter — Max...	.0655	.0772	.0886	.0992	.1122	.1215	.1475	.1675	.1935	.2226	.2821	.3407	.3981	.4574	.5163	.5745
Class 1, pitch diameter — Tol...	.0026	.0028	.0031	.0034	.0034	.0038	.0038	.0046	.0046	.0051	.0057	.0063	.0070	.0074	.0079	.0085
Class 2, pitch diameter — Max...	.0648	.0764	.0877	.0982	.1112	.1204	.1464	.1662	.1922	.2211	.2805	.3389	.3960	.4552	.5140	.5719
Class 2, pitch diameter — Tol...	.0019	.0020	.0022	.0024	.0024	.0027	.0027	.0033	.0033	.0036	.0041	.0045	.0049	.0052	.0056	.0059
Class 3, pitch diameter — Max...	.0643	.0759	.0871	.0975	.1105	.1196	.1456	.1653	.1913	.2201	.2794	.3376	.3947	.4537	.5124	.5702
Class 3, pitch diameter — Tol...	.0014	.0015	.0016	.0017	.0017	.0019	.0019	.0024	.0024	.0026	.0030	.0032	.0036	.0037	.0040	.0042
Class 4, pitch diameter — Max...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2188	.2779	.3360	.3929	.4519	.5104	.5681
Class 4, pitch diameter — Tol...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.0013	.0015	.0016	.0018	.0019	.0020	.0021

See footnotes on p. 48.

TABLE 16.—*Limiting dimensions and tolerances, classes 1, 2, 3, and 4 fits, American National coarse-thread series*—Continued

Dimensions and tolerances	Size (inches)																
	¾	⅞	1	1⅛	1¼	1⅜	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4
	Threads per inch																
	10	9	8	7	7	6	6	5	4½	4½	4	4	4	4	4	4	4
BOLTS AND SCREWS	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Class 1, major diameter — Max...	0.7472	0.8719	0.9966	1.1211	1.2461	1.3706	1.4956	1.7448	1.9943	2.2443	2.4936	2.7436	2.9936	3.2436	3.4936	3.7436	3.9936
Class 1, major diameter — Min...	.7288	.8519	.9744	1.0963	1.2213	1.3416	1.4666	1.7110	1.9575	2.2075	2.4528	2.7028	2.9528	3.2028	3.4528	3.7028	3.9528
Class 1, major diameter — Tol...	.0184	.0200	.0222	.0248	.0248	.0290	.0290	.0338	.0368	.0368	.0408	.0408	.0408	.0408	.0408	.0408	.0408
Classes 2, 3, and 4, major diameter — Max...	.7500	.8750	1.0000	1.1250	1.2500	1.3750	1.5000	1.7500	2.0000	2.2500	2.5000	2.7500	3.0000	3.2500	3.5000	3.7500	4.0000
Classes 2, 3, and 4, major diameter — Min...	.7372	.8610	.9848	1.1080	1.2330	1.3548	1.4798	1.7268	1.9746	2.2246	2.4720	2.7220	2.9720	3.2220	3.4720	3.7220	3.9720
Classes 2, 3, and 4, major diameter — Tol...	.0128	.0140	.0152	.0170	.0170	.0202	.0202	.0232	.0254	.0254	.0280	.0280	.0280	.0280	.0280	.0280	.0280
Class 2, major diameter (threaded parts of unfinished, hot-rolled material.) — Max...	.7500	.8750	1.0000	1.1250	1.2500	1.3750	1.5000	1.7500	2.0000	2.2500	2.5000	2.7500	3.0000	3.2500	3.5000	3.7500	4.0000
Class 2, major diameter (threaded parts of unfinished, hot-rolled material.) — Min...	.7316	.8550	.9778	1.1002	1.2252	1.3460	1.4710	1.7162	1.9632	2.2132	2.4592	2.7092	2.9592	3.2092	3.4592	3.7092	3.9592
Class 2, major diameter (threaded parts of unfinished, hot-rolled material.) — Tol...	.0184	.0200	.0222	.0248	.0248	.0290	.0290	.0338	.0368	.0368	.0408	.0408	.0408	.0408	.0408	.0408	.0408
Class 1, minor diameter — Max[1]..	.6245	.7356	.8432	.9458	1.0708	1.1661	1.2911	1.4994	1.7217	1.9717	2.1869	2.4369	2.6869	2.9369	3.1869	3.4369	3.6869
Classes 2, 3, and 4, minor diameter — Max[1]..	.6273	.7387	.8466	.9497	1.0747	1.1705	1.2955	1.5046	1.7274	1.9774	2.1933	2.4433	2.6933	2.9433	3.1933	3.4433	3.6933
Class 1, pitch diameter — Max[3]..	.6822	.7997	.9154	1.0283	1.1533	1.2623	1.3873	1.6149	1.8500	2.1000	2.3312	2.5812	2.8312	3.0812	3.3312	3.5812	3.8312
Class 1, pitch diameter — Min...	.6730	.7897	.9043	1.0159	1.1409	1.2478	1.3728	1.5980	1.8316	2.0816	2.3108	2.5608	2.8108	3.0608	3.3108	3.5608	3.8108
Class 1, pitch diameter — Tol...	.0092	.0100	.0111	.0124	.0124	.0145	.0145	.0169	.0184	.0184	.0204	.0204	.0204	.0204	.0204	.0204	.0204
Class 2, pitch diameter — Max[3]..	.6850	.8028	.9188	1.0322	1.1572	1.2667	1.3917	1.6201	1.8557	2.1057	2.3376	2.5876	2.8376	3.0876	3.3376	3.5876	3.8376
Class 2, pitch diameter — Min...	.6786	.7958	.9112	1.0237	1.1487	1.2566	1.3816	1.6085	1.8430	2.0930	2.3236	2.5736	2.8236	3.0736	3.3236	3.5736	3.8236
Class 2, pitch diameter — Tol...	.0064	.0070	.0076	.0085	.0085	.0101	.0101	.0116	.0127	.0127	.0140	.0140	.0140	.0140	.0140	.0140	.0140
Class 3, pitch diameter — Max[3]..	.6850	.8028	.9188	1.0322	1.1572	1.2667	1.3917	1.6201	1.8557	2.1057	2.3376	2.5876	2.8376	3.0876	3.3376	3.5876	3.8376
Class 3, pitch diameter — Min...	.6805	.7979	.9134	1.0263	1.1513	1.2596	1.3846	1.6119	1.8468	2.0968	2.3279	2.5779	2.8279	3.0779	3.3279	3.5779	3.8279
Class 3, pitch diameter — Tol...	.0045	.0049	.0054	.0059	.0059	.0071	.0071	.0082	.0089	.0089	.0097	.0097	.0097	.0097	.0097	.0097	.0097
Class 4, pitch diameter — Max[3]..	.6856	.8034	.9195	1.0330	1.1580	1.2676	1.3926	1.6211	1.8568	2.1068	2.3389	2.5889	2.8389	3.0889	3.3389	3.5889	3.8389
Class 4, pitch diameter — Min...	.6833	.8010	.9168	1.0300	1.1550	1.2640	1.3890	1.6170	1.8524	2.1024	2.3341	2.5841	2.8341	3.0841	3.3341	3.5841	3.8341
Class 4, pitch diameter — Tol...	.0023	.0024	.0027	.0030	.0030	.0036	.0036	.0041	.0044	.0044	.0048	.0048	.0048	.0048	.0048	.0048	.0048
NUTS AND TAPPED HOLES																	
Classes 1, 2, 3, and 4, major diameter.. Min[2]..	.7500	.8750	1.0000	1.1250	1.2500	1.3750	1.5000	1.7500	2.0000	2.2500	2.5000	2.7500	3.0000	3.2500	3.5000	3.7500	4.0000
Classes 1, 2, 3, and 4, minor diameter.. Min...	.6417	.7547	.8647	.9704	1.0954	1.1946	1.3196	1.5335	1.7594	2.0094	2.2294	2.4794	2.7294	2.9794	3.2294	3.4794	3.7294
Classes 1, 2, 3, and 4, minor diameter.. Max...	.6553	.7689	.8795	.9858	1.1108	1.2126	1.3376	1.5551	1.7835	2.0335	2.2564	2.5064	2.7564	3.0064	3.2564	3.5064	3.7564
Classes 1, 2, 3, and 4, minor diameter.. Tol...	.0136	.0142	.0148	.0154	.0154	.0180	.0180	.0216	.0241	.0241	.0270	.0270	.0270	.0270	.0270	.0270	.0270
Classes 1, 2, 3, and 4, pitch diameter.. Min[3]..	.6850	.8028	.9188	1.0322	1.1572	1.2667	1.3917	1.6201	1.8557	2.1057	2.3376	2.5876	2.8376	3.0876	3.3376	3.5876	3.8376
Class 1, pitch diameter — Max...	.6942	.8128	.9299	1.0446	1.1696	1.2812	1.4062	1.6370	1.8741	2.1241	2.3580	2.6080	2.8580	3.1080	3.3580	3.6080	3.8580
Class 1, pitch diameter — Tol...	.0092	.0100	.0111	.0124	.0124	.0145	.0145	.0169	.0184	.0184	.0204	.0204	.0204	.0204	.0204	.0204	.0204
Class 2, pitch diameter — Max...	.6914	.8098	.9264	1.0407	1.1657	1.2768	1.4018	1.6317	1.8684	2.1184	2.3516	2.6016	2.8516	3.1016	3.3516	3.6016	3.8516
Class 2, pitch diameter — Tol...	.0064	.0070	.0076	.0085	.0085	.0101	.0101	.0116	.0127	.0127	.0140	.0140	.0140	.0140	.0140	.0140	.0140
Class 3, pitch diameter — Max...	.6895	.8077	.9242	1.0381	1.1631	1.2738	1.3988	1.6283	1.8646	2.1146	2.3473	2.5973	2.8473	3.0973	3.3473	3.5973	3.8473
Class 3, pitch diameter — Tol...	.0045	.0049	.0054	.0059	.0059	.0071	.0071	.0082	.0089	.0089	.0097	.0097	.0097	.0097	.0097	.0097	.0097
Class 4, pitch diameter — Max...	.6873	.8052	.9215	1.0352	1.1602	1.2703	1.3953	1.6242	1.8601	2.1101	2.3424	2.5924	2.8424	3.0924	3.3424	3.5924	3.8424
Class 4, pitch diameter — Tol...	.0023	.0024	.0027	.0030	.0030	.0036	.0036	.0041	.0044	.0044	.0048	.0048	.0048	.0048	.0048	.0048	.0048

[1]Dimensions given for the maximum minor diameter of the screw are figured to the intersection of the worn tool arc with a center line through crest and root. The minimum minor diameter of the screw shall be that corresponding to a flat at the minor diameter of the minimum screw equal to $\frac{1}{8} \times p$, and may be determined by subtracting the basic thread depth, h (or $0.6495\ p$), from the minimum pitch diameter of the screw.

[2]Dimensions for the minimum major diameter of the nut correspond to the basic flat ($\frac{1}{8} \times p$) and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the nut shall be that corresponding to a flat at the major diameter of the maximum nut equal to $\frac{1}{24} \times p$, and may be determined by adding $1\frac{2}{3} \times h$ (or $0.7939\ p$) to the maximum pitch diameter of the nut.

[3]These dimensions are the maximum metal or "go" size, and are those which should be placed on the component drawing with the tolerances.

TABLE 17.—*Limiting dimensions, class 5 fit, American National coarse-thread series, steel studs set in hard materials (cast iron, semisteel, bronze, etc.)*

Sizes	Threads per inch	Stud sizes					Tapped-hole sizes					Recommended tap drill size		Approximate torque at full engagement of 1½ *D*	
		Major diameter		Pitch diameter		Minor diameter	Minor diameter		Pitch diameter		Major diameter				
		Maximum	Minimum	Maximum	Minimum	Maximum[1]	Minimum	Maximum	Minimum	Maximum	Minimum[2]	Nominal size	Diameter	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*in.-lb*	*in.-lb*
5/16.....	18	0.3125	0.3043	0.2810	0.2795	0.2489	0.2622	0.2682	0.2764	0.2790	0.3125	0.2656	0.2656	265	80
3/8.....	16	.3750	.3660	.3395	.3379	.3034	.3186	.3254	.3344	.3374	.3750	.3230	.3230	420	120
7/16.....	14	.4375	.4277	.3968	.3950	.3556	.3736	.3813	.3911	.3943	.4375	.3750	.3750	610	195
1/2.....	13	.5000	.4896	.4562	.4543	.4118	.4313	.4396	.4500	.4534	.5000	.4375	.4375	850	295
9/16.....	12	.5625	.5513	.5150	.5130	.4669	.4882	.4972	.5084	.5119	.5625	12.5 mm	.4921	1,170	425
5/8.....	11	.6250	.6132	.5729	.5708	.5204	.5444	.5542	.5660	.5696	.6250	35/64	.5469	1,450	560
3/4.....	10	.7500	.7372	.6923	.6900	.6346	.6614	.6722	.6850	.6887	.7500	43/64	.6719	2,300	880
7/8.....	9	.8750	.8610	.8102	.8078	.7461	.7768	.7888	.8028	.8065	.8750	25/32	.7812	3,200	1,230
1.....	8	1.0000	.9848	.9263	.9238	.8541	.8901	.9036	.9188	.9225	1.0000	57/64	.8906	4,250	1,630
1 1/8.....	7	1.1250	1.1080	1.0398	1.0373	.9573	.9998	1.0152	1.0322	1.0359	1.1250	1	1.0000	5,300	2,120
1 1/4.....	7	1.2500	1.2330	1.1648	1.1623	1.0823	1.1248	1.1402	1.1572	1.1609	1.2500	1 1/8	1.1250	6,950	2,780
1 3/8.....	6	1.3750	1.3548	1.2743	1.2718	1.1781	1.2286	1.2466	1.2667	1.2704	1.3750	1 15/64	1.2344	8,150	3,210
1 1/2.....	6	1.5000	1.4798	1.3998	1.3973	1.3036	1.3536	1.3716	1.3917	1.3957	1.5000	1 23/64	1.3594	10,400	4,340

[1] Dimensions given for the maximum minor diameter of the screw are figured to the intersection of the worn tool arc with a center line through crest and root. The minimum minor diameter of the screw shall be that corresponding to a flat at the minor diameter of the minimum screw equal to $\frac{1}{8} \times p$, and may be determined by subtracting the basic thread depth, h (or $0.6495p$), from the minimum pitch diameter of the screw.

[2] Dimensions for the minimum major diameter of the tapped hole correspond to the basic flat ($\frac{1}{8} \times p$), and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the tapped hole shall be that corresponding to a flat at the major diameter of the maximum tapped hole equal to $\frac{1}{24} \times p$, and may be determined by adding $1\frac{2}{9} \times h$ (or $0.7939p$) to the maximum pitch diameter of the nut.

TABLE 18.—*Limiting dimensions of setting plug and thread ring gages for screws of classes 1, 2, 3, and 4 fits, American National coarse-thread series*

Limiting dimensions			Machine screw number or nominal size										
			1	2	3	4	5	6	8	10	12	¼	5/16
			Threads per inch										
			64	56	48	40	40	32	32	24	24	20	18
"GO" GAGES FOR SCREWS			*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Class 1..	Max....	0.0727	0.0856	0.0985	0.1114	0.1244	0.1374	0.1634	0.1892	0.2152	0.2490	0.3114
		Min....	.0723	.0852	.0981	.1110	.1240	.1369	.1629	.1887	.2147	.2485	.3109
	Classes 2 and 3.	Max....	.0734	.0864	.0994	.1124	.1254	.1385	.1645	.1905	.2165	.2505	.3130
		Min....	.0730	.0860	.0990	.1120	.1250	.1380	.1640	.1900	.2160	.2500	.3125
	Class 4..	Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2508	.3133
		Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2503	.3128
Major diameter of truncated portion of truncated setting plug.	Class 1..	Max....	.0671	.0796	.0919	.1042	.1172	.1293	.1553	.1795	.2055	.2383	.2995
		Min....	.0667	.0792	.0915	.1038	.1168	.1288	.1548	.1790	.2050	.2378	.2990
	Classes 2, 3, and 4.	Max....	.0692	.0820	.0946	.1072	.1202	.1326	.1586	.1834	.2094	.2428	.3043
		Min....	.0688	.0816	.0942	.1068	.1198	.1321	.1581	.1829	.2089	.2423	.3038
Pitch diameter of setting plug or ring gage.	Class 1..	Max Y..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2158	.2746
		Min Y..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2155	.2743
		Max X..	.0622	.0736	.0846	.0948	.1078	.1166	.1426	.1616	.1876	.2160	.2748
		Min X..	.0620	.0734	.0844	.0946	.1076	.1163	.1423	.1613	.1873	.2157	.2745
	Classes 2 and 3.	Max Y..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2173	.2762
		Min Y..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2170	.2759
		Max X..	.0629	.0744	.0855	.0958	.1088	.1177	.1437	.1629	.1889	.2175	.2764
		Min X..	.0627	.0742	.0853	.0956	.1086	.1174	.1434	.1626	.1886	.2172	.2761
	Class 4..	Max W..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2178	.2767
		Min W..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2177	.2766
Minor diameter of ring gage..	Classes 1,2,3, and 4.	Max....	.0561	.0667	.0764	.0849	.0979	.1042	.1302	.1449	.1709	.1959	.2524
		Min....	.0557	.0663	.0760	.0845	.0975	.1037	.1297	.1444	.1704	.1954	.2519
"NOT GO" GAGES FOR SCREWS													
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Class 1..	Min....	.0723	.0852	.0981	.1110	.1240	.1369	.1629	.1887	.2147	.2485	.3109
		Max....	.0727	.0856	.0985	.1114	.1244	.1374	.1634	.1892	.2152	.2490	.3114
	Classes 2 and 3.	Min....	.0730	.0860	.0990	.1120	.1250	.1380	.1640	.1900	.2160	.2500	.3125
		Max....	.0734	.0864	.0994	.1124	.1254	.1385	.1645	.1905	.2165	.2505	.3130
	Class 4..	Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2503	.3128
		Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2508	.3133
Major diameter of truncated portion of truncated setting plug.	Class 1..	Min....	.0660	.0781	.0901	.1018	.1148	.1258	.1518	.1745	.2005	.2321	.2927
		Max....	.0664	.0785	.0905	.1022	.1152	.1263	.1523	.1750	.2010	.2326	.2932
	Class 2..	Min....	.0674	.0797	.0919	.1038	.1168	.1280	.1540	.1771	.2031	.2351	.2959
		Max....	.0678	.0801	.0923	.1042	.1172	.1285	.1545	.1776	.2036	.2356	.2964
	Class 3..	Min....	.0679	.0802	.0925	.1045	.1175	.1288	.1548	.1780	.2040	.2361	.2970
		Max....	.0683	.0806	.0929	.1049	.1179	.1293	.1553	.1785	.2045	.2366	.2975
	Class 4..	Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2377	.2988
		Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2382	.2993
Pitch diameter of setting plug or ring gages for production and inspection.	Class 1..	Min....	.0596	.0708	.0815	.0914	.1044	.1128	.1388	.1570	.1830	.2109	.2691
		Max....	.0598	.0710	.0817	.0916	.1046	.1131	.1391	.1573	.1833	.2112	.2694
	Class 2..	Min....	.0610	.0724	.0833	.0934	.1064	.1150	.1410	.1596	.1856	.2139	.2723
		Max....	.0612	.0726	.0835	.0936	.1066	.1153	.1413	.1599	.1859	.2142	.2726
	Class 3..	Min....	.0615	.0729	.0839	.0941	.1071	.1158	.1418	.1605	.1865	.2149	.2734
		Max....	.0617	.0731	.0841	.0943	.1073	.1161	.1421	.1608	.1868	.2152	.2737
	Class 4..	Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2165	.2752
		Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2166	.2753
(OPTIONAL) Pitch diameter of setting plug or ring gages for inspection (see par. 6, p. 31).	Class 1..	Min....	.0594	.0706	.0813	.0912	.1042	.1125	.1385	.1567	.1827	.2106	.2688
		Max....	.0596	.0708	.0815	.0914	.1044	.1128	.1388	.1570	.1830	.2109	.2691
	Class 2..	Min....	.0608	.0722	.0831	.0932	.1062	.1147	.1407	.1593	.1853	.2136	.2720
		Max....	.0610	.0724	.0833	.0934	.1064	.1150	.1410	.1596	.1856	.2139	.2723
	Class 3..	Min....	.0613	.0727	.0837	.0939	.1069	.1155	.1415	.1602	.1862	.2146	.2731
		Max....	.0615	.0729	.0839	.0941	.1071	.1158	.1418	.1605	.1865	.2149	.2734
	Class 4..	Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2164	.2751
		Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2165	.2752
Minor diameter of ring gage..	Class 1..	Min....	.0562	.0669	.0770	.0860	.0990	.1060	.1320	.1480	.1740	.2001	.2571
		Max....	.0566	.0673	.0774	.0864	.0994	.1065	.1325	.1485	.1745	.2006	.2576
	Class 2..	Min....	.0576	.0685	.0788	.0880	.1010	.1082	.1342	.1506	.1766	.2031	.2603
		Max....	.0580	.0689	.0792	.0884	.1014	.1087	.1347	.1511	.1771	.2036	.2608
	Class 3..	Min....	.0581	.0690	.0794	.0887	.1017	.1090	.1350	.1515	.1775	.2041	.2614
		Max....	.0585	.0694	.0798	.0891	.1021	.1095	.1355	.1520	.1780	.2046	.2619
	Class 4..	Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2057	.2632
		Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2062	.2637

TABLE 18.—*Limiting dimensions of setting, plug and thread ring gages for screws of classes 1, 2, 3, and 4 fits, American National coarse-thread series—Continued*

Limiting dimensions			Size (inches)										
			3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8
			Threads per inch										
			16	14	13	12	11	10	9	8	7	7	6
"GO" GAGES FOR SCREWS			*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Class 1..	Max....	0.3738	0.4360	0.4984	0.5507	0.6230	0.7478	0.8726	0.9973	1.1218	1.2468	1.3714
		Min....	.3732	.4354	.4978	.5601	.6224	.7472	.8719	.9966	1.1211	1.2461	1.3706
	Classes 2 and 3.	Max....	.3756	.4381	.5006	.5631	.6256	.7506	.8757	1.0007	1.1257	1.2507	1.3758
		Min....	.3750	.4375	.5000	.5625	.6250	.7500	.8750	1.0000	1.1250	1.2500	1.3750
	Class 4..	Max....	.3760	.4385	.5010	.5636	.6261	.7512	.8763	1.0014	1.1265	1.2515	1.3767
		Min....	.3754	.4379	.5004	.5630	.6255	.7506	.8756	1.0007	1.1258	1.2508	1.3759
Major diameter of truncated portion of truncated setting plug.	Class 1..	Max....	.3606	.4214	.4830	.5443	.6054	.7288	.8519	.9744	1.0963	1.2213	1.3416
		Min....	.3600	.4208	.4824	.5437	.6048	.7282	.8512	.9737	1.0956	1.2206	1.3408
	Classes 2, 3, and 4.	Max....	.3660	.4277	.4896	.5513	.6132	.7372	.8610	.9848	1.1080	1.2330	1.3548
		Min....	.3654	.4271	.4890	.5507	.6126	.7366	.8603	.9841	1.1073	1.2323	1.3540
Pitch diameter of setting plug or ring gage.	Class 1..	Max Y..	.3324	.3888	.4476	.5058	.5632	.6820	.7995	.9152	1.0281	1.1531	1.2620
		Min Y..	.3320	.3884	.4472	.5054	.5628	.6816	.7990	.9147	1.0276	1.1526	1.2615
		Max X..	.3326	.3890	.4478	.5060	.5634	.6822	.7997	.9154	1.0283	1.1533	1.2623
		Min X..	.3323	.3887	.4475	.5057	.5631	.6819	.7994	.9150	1.0279	1.1529	1.2619
	Classes 2 and 3.	Max Y..	.3342	.3909	.4498	.5082	.5658	.6848	.8026	.9186	1.0320	1.1570	1.2664
		Min Y..	.3338	.3905	.4494	.5078	.5654	.6844	.8021	.9181	1.0315	1.1565	1.2659
		Max X..	.3344	.3911	.4500	.5084	.5660	.6850	.8028	.9188	1.0322	1.1572	1.2667
		Min X..	.3341	.3908	.4497	.5081	.5657	.6847	.8025	.9184	1.0318	1.1568	1.2663
	Class 4..	Max W..	.3348	.3915	.4504	.5089	.5665	.6856	.8034	.9195	1.0330	1.1580	1.2676
		Min W..	.3347	.39135	.45025	.5087	.5663	.6854	.8032	.9193	1.0328	1.1578	1.2674
Minor diameter of ring gage.	Classes 1,2,3, and 4.	Max....	.3073	.3602	.4167	.4723	.5266	.6417	.7647	.8647	0.9704	1.0954	1.1946
		Min....	.3067	.3596	.4161	.4717	.5260	.6411	.7640	.8640	.9697	1.0947	1.1938
"NOT GO" GAGES FOR SCREWS													
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Class 1..	Min....	.3732	.4354	.4978	.5601	.6224	.7472	.8719	.9966	1.1211	1.2461	1.3706
		Max....	.3738	.4360	.4984	.5607	.6230	.7478	.8726	.9973	1.1218	1.2468	1.3714
	Classes 2 and 3.	Min....	.3750	.4375	.5000	.5625	.6250	.7500	.8750	1.0000	1.1250	1.2500	1.3750
		Max....	.3756	.4381	.5006	.5631	.6256	.7506	.8757	1.0007	1.1257	1.2507	1.3758
	Class 4..	Min....	.3754	.4379	.5004	.5630	.6255	.7506	.8756	1.0007	1.1258	1.2508	1.3759
		Max....	.3760	.4385	.5010	.5636	.6261	.7512	.8763	1.0014	1.1265	1.2515	1.3767
Major diameter of truncated portion of truncated setting plug.	Class 1..	Min....	.3528	.4123	.4731	.5336	.5937	.7157	.8371	0.9577	1.0771	1.2021	1.3192
		Max....	.3534	.4129	.4737	.5342	.5943	.7163	.8378	.9584	1.0778	1.2028	1.3200
	Class 2..	Min....	.3564	.4165	.4775	.5383	.5989	.7213	.8432	.9646	1.0849	1.2099	1.3280
		Max....	.3570	.4171	.4781	.5389	.5995	.7219	.8439	.9653	1.0856	1.2106	1.3288
	Class 3..	Min....	.3577	.4178	.4790	.5399	.6006	.7232	.8453	.9668	1.0875	1.2125	1.3310
		Max....	.3583	.4184	.4796	.5405	.6012	.7238	.8460	.9675	1.0882	1.2132	1.3318
	Class 4..	Min....	.3597	.4200	.4812	.5424	.6032	.7260	.8484	.9702	1.0912	1.2162	1.3354
		Max....	.3603	.4206	.4818	.5430	.6038	.7266	.8491	.9709	1.0919	1.2169	1.3362
Pitch diameter of setting plug or ring gages for production and inspection.	Class 1..	Min....	.3263	.3820	.4404	.4981	.5549	.6730	.7897	.9043	1.0159	1.1409	1.2478
		Max....	.3266	.3823	.4407	.4984	.5552	.6733	.7900	.9047	1.0163	1.1413	1.2482
	Class 2..	Min....	.3299	.3862	.4448	.5028	.5601	.6786	.7958	.9112	1.0237	1.1487	1.2566
		Max....	.3302	.3865	.4451	.5031	.5604	.6789	.7961	.9116	1.0241	1.1491	1.2570
	Class 3..	Min....	.3312	.3875	.4463	.5044	.5618	.6805	.7979	.9134	1.0263	1.1513	1.2596
		Max....	.3315	.3878	.4466	.5047	.5621	.6808	.7982	.9138	1.0267	1.1517	1.2600
	Class 4..	Min....	.3332	.3897	.4485	.5069	.5644	.6833	.8010	.9168	1.0300	1.1550	1.2640
		Max....	.3333	.38985	.44865	.5071	.5646	.6835	.8012	.9170	1.0302	1.1552	1.2642
(OPTIONAL) Pitch diameter of setting plug or ring gages for inspection (see par. 6, p. 31).	Class 1..	Min....	.3260	.3817	.4401	.4978	.5546	.6727	.7894	.9039	1.0155	1.1405	1.2474
		Max....	.3263	.3820	.4404	.4981	.5549	.6730	.7897	.9043	1.0159	1.1409	1.2478
	Class 2..	Min....	.3296	.3859	.4445	.5025	.5598	.6783	.7955	.9108	1.0233	1.1483	1.2562
		Max....	.3299	.3862	.4448	.5028	.5601	.6786	.7958	.9112	1.0237	1.1487	1.2566
	Class 3..	Min....	.3309	.3872	.4460	.5041	.5615	.6802	.7976	.9130	1.0259	1.1509	1.2592
		Max....	.3312	.3875	.4463	.5044	.5618	.6805	.7979	.9134	1.0263	1.1513	1.2596
	Class 4..	Min....	.3331	.38955	.44835	.5067	.5642	.6831	.8008	.9166	1.0298	1.1548	1.2638
		Max....	.3332	.3897	.4485	.5069	.5644	.6833	.8010	.9168	1.0300	1.1550	1.2640
Minor diameter of ring gage.	Class 1..	Min....	.3128	.3665	.4238	.4801	.5352	.6514	.7656	.8772	0.9850	1.1100	1.2117
		Max....	.3134	.3671	.4244	.4807	.5358	.6520	.7663	.8779	.9857	1.1107	1.2125
	Class 2..	Min....	.3164	.3707	.4282	.4848	.5404	.6570	.7717	.8841	.9928	1.1178	1.2205
		Max....	.3170	.3713	.4288	.4854	.5410	.6576	.7724	.8848	.9935	1.1185	1.2213
	Class 3..	Min....	.3177	.3720	.4297	.4864	.5421	.6589	.7738	.8863	.9954	1.1204	1.2235
		Max....	.3183	.3726	.4303	.4870	.5427	.6595	.7745	.8870	.9961	1.1211	1.2243
	Class 4..	Min....	.3197	.3742	.4319	.4889	.5447	.6617	.7769	.8897	.9991	1.1241	1.2279
		Max....	.3203	.3748	.4325	.4895	.5453	.6623	.7776	.8904	.9998	1.1248	1.2287

TABLE 18.—*Limiting dimensions of setting plug and thread ring gages for screws of classes 1, 2, 3, and 4 fits, American National coarse-thread series*—Continued

Limiting dimensions			Size (inches)										
			1½	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4
			Threads per inch										
			6	5	4½	4½	4	4	4	4	4	4	4
"GO" GAGES FOR SCREWS			*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Class 1..	Max....	1.4964	1.7456	1.9951	2.2451	2.4945	2.7445	2.9945	3.2445	3.4945	3.7445	3.9945
		Min....	1.4956	1.7448	1.9943	2.2443	2.4936	2.7436	2.9936	3.2436	3.4936	3.7436	3.9936
	Classes 2 and 3.	Max....	1.5008	1.7508	2.0008	2.2508	2.5009	2.7509	3.0009	3.2509	3.5009	3.7509	4.0009
		Min....	1.5000	1.7500	2.0000	2.2500	2.5000	2.7500	3.0000	3.2500	3.5000	3.7500	4.0000
	Class 4..	Max....	1.5017	1.7518	2.0019	2.2519	2.5022	2.7522	3.0022	3.2522	3.5022	3.7522	4.0022
		Min....	1.5009	1.7510	2.0011	2.2511	2.5013	2.7513	3.0013	3.2513	3.5013	3.7513	4.0013
Major diameter of truncated portion of truncated setting plug.	Class 1..	Max....	1.4666	1.7110	1.9575	2.2075	2.4528	2.7028	2.9528	3.2028	3.4528	3.7028	3.9528
		Min....	1.4658	1.7102	1.9567	2.2067	2.4519	2.7019	2.9519	3.2019	3.4519	3.7019	3.9519
	Classes 2, 3, and 4.	Max....	1.4798	1.7268	1.9746	2.2246	2.4720	2.7220	2.9720	3.2220	3.4720	3.7220	3.9720
		Min....	1.4790	1.7260	1.9738	2.2238	2.4711	2.7211	2.9711	3.2211	3.4711	3.7211	3.9711
Pitch diameter of setting plug or ring gage.	Class 1..	Max Y..	1.3870	1.6146	1.8497	2.0997	2.3309	2.5809	2.8309	3.0809	3.3309	3.5809	3.8309
		Min Y..	1.3865	1.6139	1.8490	2.0990	2.3301	2.5801	2.8301	3.0801	3.3301	3.5801	3.8301
		Max X..	1.3873	1.6149	1.8500	2.1000	2.3312	2.5812	2.8312	3.0812	3.3312	3.5812	3.8312
		Min X..	1.3869	1.6144	1.8495	2.0995	2.3307	2.5807	2.8307	3.0807	3.3307	3.5807	3.8307
	Classes 2 and 3.	Max Y..	1.3914	1.6198	1.8554	2.1054	2.3373	2.5873	2.8373	3.0873	3.3373	3.5873	3.8373
		Min Y..	1.3909	1.6191	1.8547	2.1047	2.3365	2.5865	2.8365	3.0865	3.3365	3.5865	3.8365
		Max X..	1.3917	1.6201	1.8557	2.1057	2.3376	2.5876	2.8376	3.0876	3.3376	3.5876	3.8376
		Min X..	1.3913	1.6196	1.8552	2.1052	2.3371	2.5871	2.8371	3.0871	3.3371	3.5871	3.8371
	Class 4..	Max W..	1.3926	1.6211	1.8568	2.1068	2.3389	2.5889	2.8389	3.0889	3.3389	3.5889	3.8389
		Min W..	1.3924	1.62085	1.85655	2.10655	2.33865	2.58865	2.83865	3.08865	3.33865	3.58865	3.83865
Minor diameter of ring gage.	Classes 1, 2,3,and 4.	Max....	1.3196	1.5335	1.7594	2.0094	2.2294	2.4794	2.7294	2.9794	3.2294	3.4794	3.7294
		Min....	1.3188	1.5327	1.7586	2.0086	2.2285	2.4785	2.7285	2.9785	3.2285	3.4785	3.7285
"NOT GO" GAGES FOR SCREWS													
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Class 1..	Min....	1.4956	1.7448	1.9943	2.2443	2.4936	2.7436	2.9936	3.2436	3.4936	3.7436	3.9936
		Max....	1.4964	1.7456	1.9951	2.2451	2.4945	2.7445	2.9945	3.2445	3.4945	3.7445	3.9945
	Classes 2 and 3.	Min....	1.5000	1.7500	2.0000	2.2500	2.5000	2.7500	3.0000	3.2500	3.5000	3.7500	4.0000
		Max....	1.5008	1.7508	2.0008	2.2508	2.5009	2.7509	3.0009	3.2509	3.5009	3.7509	4.0009
	Class 4..	Min....	1.5009	1.7510	2.0011	2.2511	2.5013	2.7513	3.0013	3.2513	3.5013	3.7513	4.0013
		Max....	1.5017	1.7518	2.0019	2.2520	2.5022	2.7522	3.0022	3.2522	3.5022	3.7522	4.0022
Major diameter of truncated portion of truncated setting plug.	Class 1..	Min....	1.4442	1.6838	1.9270	2.1770	2.4182	2.6682	2.9182	3.1682	3.4182	3.6682	3.9182
		Max....	1.4450	1.6846	1.9278	2.1778	2.4191	2.6691	2.9191	3.1691	3.4191	3.6691	3.9191
	Class 2..	Min....	1.4530	1.6943	1.9384	2.1884	2.4310	2.6810	2.9310	3.1810	3.4310	3.6810	3.9310
		Max....	1.4538	1.6951	1.9392	2.1892	2.4319	2.6819	2.9319	3.1819	3.4319	3.6819	3.9319
	Class 3..	Min....	1.4560	1.6977	1.9422	2.1922	2.4353	2.6853	2.9353	3.1853	3.4353	3.6853	3.9353
		Max....	1.4568	1.6985	1.9430	2.1930	2.4362	2.6862	2.9362	3.1862	3.4362	3.6862	3.9362
	Class 4..	Min....	1.4604	1.7028	1.9478	2.1978	2.4415	2.6915	2.9415	3.1915	3.4415	3.6915	3.9415
		Max....	1.4612	1.7036	1.9486	2.1986	2.4424	2.6924	2.9424	3.1924	3.4424	3.6924	3.9424
Pitch diameter of setting plug or ring gages for production and inspection.	Class 1..	Min....	1.3728	1.5980	1.8316	2.0816	2.3108	2.5608	2.8108	3.0608	3.3108	3.5608	3.8108
		Max....	1.3732	1.5985	1.8321	2.0821	2.3113	2.5613	2.8113	3.0613	3.3113	3.5613	3.8113
	Class 2..	Min....	1.3816	1.6085	1.8430	2.0930	2.3236	2.5736	2.8236	3.0736	3.3236	3.5736	3.8236
		Max....	1.3820	1.6090	1.8435	2.0935	2.3241	2.5741	2.8241	3.0741	3.3241	3.5741	3.8241
	Class 3..	Min....	1.3846	1.6119	1.8468	2.0968	2.3279	2.5779	2.8279	3.0779	3.3279	3.5779	3.8279
		Max....	1.3850	1.6124	1.8473	2.0973	2.3284	2.5784	2.8284	3.0784	3.3284	3.5784	3.8284
	Class 4..	Min....	1.3890	1.6170	1.8524	2.1024	2.3341	2.5841	2.8341	3.0841	3.3341	3.5841	3.8341
		Max....	1.3892	1.61725	1.85265	2.10265	2.33435	2.58435	2.83435	3.08435	3.33435	3.58435	3.83435
(OPTIONAL) Pitch diameter of setting plug or ring gages for inspection. (See par. 6, p. 31.)	Class 1..	Min....	1.3724	1.5975	1.8311	2.0811	2.3103	2.5603	2.8103	3.0603	3.3103	3.5603	3.8103
		Max....	1.3728	1.5980	1.8316	2.0816	2.3108	2.5608	2.8108	3.0608	3.3108	3.5608	3.8108
	Class 2..	Min....	1.3812	1.6080	1.8425	2.0925	2.3231	2.5731	2.8231	3.0731	3.3231	3.5731	3.8231
		Max....	1.3816	1.6085	1.8430	2.0930	2.3236	2.5736	2.8236	3.0736	3.3236	3.5736	3.8236
	Class 3..	Min....	1.3842	1.6114	1.8463	2.0963	2.3274	2.5774	2.8274	3.0774	3.3274	3.5774	3.8274
		Max....	1.3846	1.6119	1.8468	2.0968	2.3279	2.5779	2.8279	3.0779	3.3279	3.5779	3.8279
	Class 4..	Min....	1.3888	1.61675	1.85215	2.10215	2.33385	2.58385	2.83385	3.08385	3.33385	3.58385	3.83385
		Max....	1.3890	1.6170	1.8524	2.1024	2.3341	2.5841	2.8341	3.0841	3.3341	3.5841	3.8341
Minor diameter of ring gage.	Class 1..	Min....	1.3367	1.5547	1.7835	2.0335	2.2567	2.5067	2.7567	3.0067	3.2567	3.5067	3.7567
		Max....	1.3375	1.5555	1.7843	2.0343	2.2576	2.5076	2.7576	3.0076	3.2576	3.5076	3.7576
	Class 2..	Min....	1.3455	1.5652	1.7949	2.0449	2.2695	2.5195	2.7695	3.0195	3.2695	3.5195	3.7695
		Max....	1.3463	1.5660	1.7957	2.0457	2.2704	2.5204	2.7704	3.0204	3.2704	3.5204	3.7704
	Class 3..	Min....	1.3485	1.5686	1.7987	2.0487	2.2738	2.5238	2.7738	3.0238	3.2738	3.5238	3.7738
		Max....	1.3493	1.5694	1.7995	2.0495	2.2747	2.5247	2.7747	3.0247	3.2747	3.5247	3.7747
	Class 4..	Min....	1.3529	1.5737	1.8043	2.0543	2.2800	2.5300	2.7800	3.0300	3.2800	3.5300	3.7800
		Max....	1.3537	1.5745	1.8051	2.0551	2.2809	2.5309	2.7809	3.0309	3.2809	3.5309	3.7809

TABLE 19.—*Limiting dimensions of thread plug gages for nuts of classes 1, 2, 3, and 4 fits, American National coarse-thread series*

Limiting dimensions			Machine screw number or nominal size																
			1	2	3	4	5	6	8	10	12	¼	5/16	3/8	7/16	½	9/16	5/8	¾	7/8
			Threads per inch																
			64	56	48	40	40	32	32	24	24	20	18	16	14	13	12	11	10	9
"GO" GAGES FOR NUTS																			
Major diameter of plug gage.	Classes 1, 2, 3, and 4.	Min....	*Inch* 0.0730	*Inch* 0.0860	*Inch* 0.0990	*Inch* 0.1120	*Inch* 0.1250	*Inch* 0.1380	*Inch* 0.1640	*Inch* 0.1900	*Inch* 0.2160	*Inch* 0.2500	*Inch* 0.3125	*Inch* 0.3750	*Inch* 0.4375	*Inch* 0.5000	*Inch* 0.5625	*Inch* 0.6250	*Inch* 0.7500	*Inch* 0.8750
		Max....	.0734	.0864	.0994	.1124	.1254	.1385	.1645	.1905	.2165	.2505	.3130	.3756	.4381	.5006	.5631	.6256	.7506	.8757
Pitch diameter of plug gage.	Classes 1, 2, and 3.	Min Y..	.0630	.0745	.0856	.0959	.1089	.1178	.1438	.1631	.1891	.2177	.2766	.3346	.3913	.4502	.5086	.5662	.6852	.8030
		Max Y..	.0633	.0748	.0859	.0962	.1092	.1181	.1441	.1634	.1894	.2180	.2769	.3350	.3917	.4506	.5090	.5666	.6856	.8035
		Min X..	.0629	.0744	.0855	.0958	.1088	.1177	.1437	.1629	.1889	.2175	.2764	.3344	.3911	.4500	.5084	.5660	.6850	.8028
		Max X..	.0631	.0746	.0857	.0960	.1090	.1180	.1440	.1632	.1892	.2178	.2767	.3347	.3914	.4503	.5087	.5663	.6853	.8031
	Class 4.....	Min W..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2175	.2764	.3344	.3911	.4500	.5084	.5660	.6850	.8028
		Max W..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2176	.2765	.3345	.39125	.45015	.5086	.5662	.6852	.8030
"NOT GO" GAGES FOR NUTS																			
Major diameter of plug gage.	Class 1.....	Max....	.0723	.0849	.0976	.1100	.1230	.1350	.1610	.1855	.2115	.2443	.3062	.3678	.4290	.4907	.5524	.6139	.7375	.8609
		Min....	.0719	.0845	.0972	.1096	.1226	.1345	.1605	.1850	.2110	.2438	.3057	.3672	.4284	.4901	.5518	.6133	.7369	.8602
	Class 2.....	Max....	.0716	.0841	.0967	.1090	.1220	.1339	.1599	.1842	.2102	.2428	.3046	.3660	.4269	.4885	.5501	.6113	.7347	.8579
		Min....	.0712	.0837	.0963	.1086	.1216	.1334	.1594	.1837	.2097	.2423	.3041	.3654	.4263	.4879	.5495	.6107	.7341	.8572
	Class 3.....	Max....	.0711	.0836	.0961	.1083	.1213	.1331	.1591	.1833	.2093	.2418	.3035	.3647	.4256	.4870	.5485	.6096	.7328	.8558
		Min....	.0707	.0832	.0957	.1079	.1209	.1326	.1586	.1828	.2088	.2413	.3030	.3641	.4250	.4864	.5479	.6090	.7322	.8551
	Class 4.....	Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2405	.3020	.3631	.4238	.4852	.5465	.6075	.7306	.8533
		Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2400	.3015	.3625	.4232	.4846	.5459	.6069	.7300	.8526
Pitch diameter of thread plug gages for production and inspection.	Class 1.....	Max....	.0655	.0772	.0886	.0992	.1122	.1215	.1475	.1675	.1935	.2226	.2821	.3407	.3981	.4574	.5163	.5745	.6942	.8128
		Min....	.0653	.0770	.0884	.0990	.1120	.1212	.1472	.1672	.1932	.2223	.2818	.3404	.3978	.4571	.5160	.5742	.6939	.8125
	Class 2.....	Max....	.0648	.0764	.0877	.0982	.1112	.1204	.1464	.1662	.1922	.2211	.2805	.3389	.3960	.4552	.5140	.5719	.6914	.8098
		Min....	.0646	.0762	.0875	.0980	.1110	.1201	.1461	.1659	.1919	.2208	.2802	.3386	.3957	.4549	.5137	.5716	.6911	.8095
	Class 3.....	Max....	.0643	.0759	.0871	.0975	.1105	.1196	.1456	.1653	.1913	.2201	.2794	.3376	.3947	.4537	.5124	.5702	.6895	.8077
		Min....	.0641	.0757	.0869	.0973	.1103	.1193	.1453	.1650	.1910	.2198	.2791	.3373	.3944	.4534	.5121	.5699	.6892	.8074
	Class 4.....	Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2188	.2779	.3360	.3929	.4519	.5104	.5681	.6873	.8052
		Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2187	.2778	.3359	.39275	.45175	.5102	.5679	.6871	.8050
	(OPTIONAL)																		
Pitch diameter of thread plug gages for inspection (see par. 6, p. 31).	Class 1.....	Max....	.0657	.0774	.0888	.0994	.1124	.1218	.1478	.1678	.1938	.2229	.2824	.3410	.3984	.4577	.5166	.5748	.6945	.8131
		Min....	.0655	.0772	.0886	.0992	.1122	.1215	.1475	.1675	.1935	.2226	.2821	.3407	.3981	.4574	.5163	.5745	.6942	.8128
	Class 2.....	Max....	.0650	.0766	.0879	.0984	.1114	.1207	.1467	.1665	.1925	.2214	.2808	.3392	.3963	.4555	.5143	.5722	.6917	.8101
		Min....	.0648	.0764	.0877	.0982	.1112	.1204	.1464	.1662	.1922	.2211	.2805	.3389	.3960	.4552	.5140	.5719	.6914	.8098
	Class 3.....	Max....	.0645	.0761	.0873	.0977	.1107	.1199	.1459	.1656	.1916	.2204	.2797	.3379	.3950	.4540	.5127	.5705	.6898	.8080
		Min....	.0643	.0759	.0871	.0975	.1105	.1196	.1456	.1653	.1913	.2201	.2794	.3376	.3947	.4537	.5124	.5702	.6895	.8077
	Class 4.....	Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2189	.2780	.3361	.39305	.45205	.5106	.5683	.6875	.8054
		Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2188	.2779	.3360	.3929	.4519	.5104	.5681	.6873	.8052

TABLE 19.—*Limiting dimensions of thread plug gages for nuts of classes 1, 2, 3, and 4 fits. American National coarse-thread series*—Continued

Limiting dimensions			Size (inches)													
			1	1⅛	1¼	1⅜	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4
			Threads per inch														
			8	7	7	6	6	5	4½	4½	4	4	4	4	4	4	4
"GO" GAGES FOR NUTS			*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage.	Classes 1, 2, 3, and 4.	Min....	1.0000	1.1250	1.2500	1.3750	1.5000	1.7500	2.0000	2.2500	2.5000	2.7500	3.0000	3.2500	3.5000	3.7500	4.0000
		Max....	1.0007	1.1257	1.2507	1.3758	1.5008	1.7508	2.0008	2.2508	2.5009	2.7509	3.0009	3.2509	3.5009	3.7509	4.0009
Pitch diameter of plug gage.	Classes 1, 2, and 3.	Min Y..	.9190	1.0324	1.1574	1.2670	1.3920	1.6204	1.8560	2.1060	2.3379	2.5879	2.8379	3.0879	3.3379	3.5879	3.8379
		Max Y..	.9195	1.0329	1.1579	1.2675	1.3925	1.6211	1.8567	2.1067	2.3387	2.5887	2.8387	3.0887	3.3387	3.5887	3.8387
		Min X..	.9188	1.0322	1.1572	1.2667	1.3917	1.6201	1.8557	2.1057	2.3376	2.5876	2.8376	3.0876	3.3376	3.5876	3.8376
		Max X..	.9192	1.0326	1.1576	1.2671	1.3921	1.6206	1.8562	2.1062	2.3381	2.5881	2.8381	3.0881	3.3381	3.5881	3.8381
	Class 4.....	Min W..	.9188	1.0322	1.1572	1.2667	1.3917	1.6201	1.8557	2.1057	2.3376	2.5876	2.8376	3.0876	3.3376	3.5876	3.8376
		Max W..	.9190	1.0324	1.1574	1.2669	1.3919	1.62035	1.85595	2.10595	2.33785	2.58785	2.83785	3.08785	3.33785	3.58785	3.83785
"Not GO" GAGES FOR NUTS																	
Major diameter of plug gage.	Class 1.....	Max....	.9840	1.1065	1.2315	1.3534	1.4784	1.7236	1.9708	2.2208	2.4663	2.7163	2.9663	3.2163	3.4663	3.7163	3.9663
		Min....	.9833	1.1058	1.2308	1.3526	1.4776	1.7228	1.9695	2.2195	2.4654	2.7154	2.9654	3.2154	3.4654	3.7154	3.9654
	Class 2.....	Max....	.9805	1.1026	1.2276	1.3490	1.4740	1.7183	1.9646	2.2146	2.4599	2.7099	2.9599	3.2099	3.4599	3.7099	3.9599
		Min....	.9798	1.1019	1.2269	1.3482	1.4732	1.7175	1.9638	2.2138	2.4590	2.7090	2.9590	3.2090	3.4590	3.7090	3.9590
	Class 3.....	Max....	.9783	1.1000	1.2250	1.3460	1.4710	1.7149	1.9608	2.2108	2.4556	2.7056	2.9556	3.2056	3.4556	3.7056	3.9556
		Min....	.9776	1.0993	1.2243	1.3452	1.4702	1.7141	1.9600	2.2100	2.4547	2.7047	2.9547	3.2047	3.4547	3.7047	3.9547
	Class 4.....	Max....	.9756	1.0971	1.2221	1.3425	1.4675	1.7108	1.9563	2.2063	2.4507	2.7007	2.9507	3.2007	3.4507	3.7007	3.9507
		Min....	.9749	1.0964	1.2214	1.3417	1.4667	1.7100	1.9555	2.2055	2.4498	2.6998	2.9498	3.1998	3.4498	3.6998	3.9498
Pitch diameter of thread plug gages for production and inspection.	Class 1.....	Max....	.9299	1.0446	1.1696	1.2812	1.4062	1.6370	1.8741	2.1241	2.3580	2.6080	2.8580	3.1080	3.3580	3.6080	3.8580
		Min....	.9295	1.0442	1.1692	1.2808	1.4058	1.6365	1.8736	2.1236	2.3575	2.6075	2.8575	3.1075	3.3575	3.6075	3.8575
	Class 2.....	Max....	.9264	1.0407	1.1657	1.2768	1.4018	1.6317	1.8684	2.1184	2.3516	2.6016	2.8516	3.1016	3.3516	3.6016	3.8516
		Min....	.9260	1.0403	1.1653	1.2764	1.4014	1.6312	1.8679	2.1179	2.3511	2.6011	2.8511	3.1011	3.3511	3.6011	3.8511
	Class 3.....	Max....	.9242	1.0381	1.1631	1.2738	1.3988	1.6283	1.8646	2.1146	2.3473	2.5973	2.8473	3.0973	3.3473	3.5973	3.8473
		Min....	.9238	1.0377	1.1627	1.2734	1.3984	1.6278	1.8641	2.1141	2.3468	2.5968	2.8468	3.0968	3.3468	3.5968	3.8468
	Class 4.....	Max....	.9215	1.0352	1.1602	1.2703	1.3953	1.6242	1.8601	2.1101	2.3424	2.5924	2.8424	3.0924	3.3424	3.5924	3.8424
		Min....	.9213	1.0350	1.1600	1.2701	1.3951	1.62395	1.85985	2.10985	2.34215	2.59215	2.84215	3.09215	3.34215	3.59215	3.84215
(OPTIONAL)																	
Pitch diameter of thread plug gages for inspection (see par. 6, p. 31).	Class 1.....	Max....	.9303	1.0450	1.1700	1.2816	1.4066	1.6375	1.8746	2.1246	2.3585	2.6085	2.8585	3.1085	3.3585	3.6085	3.8585
		Min....	.9299	1.0446	1.1696	1.2812	1.4062	1.6370	1.8741	2.1241	2.3580	2.6080	2.8580	3.1080	3.3580	3.6080	3.8580
	Class 2.....	Max....	.9268	1.0411	1.1661	1.2772	1.4022	1.6322	1.8689	2.1189	2.3521	2.6021	2.8521	3.1021	3.3521	3.6021	3.8521
		Min....	.9264	1.0407	1.1657	1.2768	1.4018	1.6317	1.8684	2.1184	2.3516	2.6016	2.8516	3.1016	3.3516	3.6016	3.8516
	Class 3.....	Max....	.9246	1.0385	1.1635	1.2742	1.3992	1.6288	1.8651	2.1151	2.3478	2.5978	2.8478	3.0978	3.3478	3.5978	3.8478
		Min....	.9242	1.0381	1.1631	1.2738	1.3988	1.6283	1.8646	2.1146	2.3473	2.5973	2.8473	3.0973	3.3473	3.5973	3.8473
	Class 4.....	Max....	.9217	1.0354	1.1604	1.2705	1.3955	1.62445	1.86035	2.11035	2.34265	2.59265	2.84265	3.09265	3.34265	3.59265	3.84265
		Min....	.9215	1.0352	1.1602	1.2703	1.3953	1.6242	1.8601	2.1101	2.3424	2.5924	2.8424	3.0924	3.3424	3.5924	3.8424

TABLE 20.—*Limiting dimensions of plain gages for screws and nuts of classes 1, 2, 3, and 4 fits, American National coarse-thread series*

Size	Threads per inch	Gages for major diameter of screw								Gages for minor diameter of nut			
		"Go" gages				"Not go" gages				"Go" gage		"Not go" gage	
		Class 1		Classes 2, 3, and 4		Class 1		Classes 2, 3, and 4[1]		Minimum	Maximum	Maximum	Minimum
		Maximum	Minimum	Maximum	Minimum	Minimum	Maximum	Minimum	Maximum				
1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1	64	0.07230	0.07223	0.07300	0.07293	0.06710	0.06717	0.06920	0.06927	0.05610	0.05617	0.06230	0.06223
2	56	.08520	.08513	.08600	.08593	.07960	.07967	.08200	.08207	.06670	.06677	.07370	.07363
3	48	.09810	.09803	.09900	.09893	.09190	.09197	.09460	.09467	.07640	.07647	.08410	.08403
4	40	.11100	.11093	.11200	.11193	.10420	.10427	.10720	.10727	.08490	.08497	.09380	.09373
5	40	.12400	.12393	.12500	.12493	.11720	.11727	.12020	.12027	.09790	.09797	.10620	.10613
6	32	.13690	.13683	.13800	.13793	.12930	.12937	.13260	.13267	.10420	.10427	.11450	.11443
8	32	.16290	.16283	.16400	.16393	.15530	.15537	.15860	.15867	.13020	.13027	.13840	.13833
10	24	.18870	.18863	.19000	.18993	.17950	.17957	.18340	.18347	.14490	.14497	.15590	.15583
12	24	.21470	.21463	.21600	.21593	.20550	.20557	.20940	.20947	.17090	.17097	.18010	.18003
1/4	20	.24850	.24843	.25000	.24993	.23830	.23837	.24280	.24287	.19590	.19597	.20600	.20593
5/16	18	.31090	.31083	.31250	.31243	.29950	.29957	.30430	.30437	.25240	.25247	.26300	.26293
3/8	16	.37320	.37313	.37500	.37493	.36060	.36067	.36600	.36607	.30730	.30737	.31840	.31833
7/16	14	.43540	.43533	.43750	.43743	.42140	.42147	.42770	.42777	.36020	.36027	.37210	.37203
1/2	13	.49780	.49773	.50000	.49993	.48300	.48307	.48960	.48967	.41670	.41677	.42900	.42893
9/16	12	.56010	.56003	.56250	.56243	.54430	.54437	.55130	.55137	.47230	.47237	.48500	.48493
5/8	11	.62240	.62233	.62500	.62493	.60540	.60547	.61320	.61327	.52660	.52667	.53970	.53963
3/4	10	.74720	.74713	.75000	.74993	.72880	.72887	.73720	.73727	.64170	.64177	.65530	.65523
7/8	9	.87190	.87181	.87500	.87491	.85190	.85199	.86100	.86109	.75470	.75477	.76890	.76883
1	8	.99660	.99651	1.00000	.99991	.97440	.97449	.98480	.98489	.86470	.86479	.87950	.87941
1 1/8	7	1.12110	1.12101	1.12500	1.12491	1.09630	1.09639	1.10800	1.10809	.97040	.97049	.98580	.98571
1 1/4	7	1.24610	1.24601	1.25000	1.24991	1.22130	1.22139	1.23300	1.23309	1.09540	1.09549	1.11080	1.11071
1 3/8	6	1.37060	1.37051	1.37500	1.37491	1.34160	1.34169	1.35480	1.35489	1.19460	1.19469	1.21260	1.21251
1 1/2	6	1.49560	1.49551	1.50000	1.49991	1.46660	1.46669	1.47980	1.47989	1.31960	1.31969	1.33760	1.33751
1 3/4	5	1.74480	1.74468	1.75000	1.74988	1.71100	1.71112	1.72680	1.72692	1.53350	1.53362	1.55510	1.55498
2	4 1/2	1.99430	1.99418	2.00000	1.99988	1.95750	1.95762	1.97460	1.97472	1.75940	1.75952	1.78350	1.78338
2 1/4	4 1/2	2.24430	2.24418	2.25000	2.24988	2.20750	2.20762	2.22460	2.22472	2.00940	2.00952	2.03350	2.03338
2 1/2	4	2.49360	2.49348	2.50000	2.49988	2.45280	2.45292	2.47200	2.47212	2.22940	2.22952	2.25640	2.25628
2 3/4	4	2.74360	2.74345	2.75000	2.74985	2.70280	2.70295	2.72200	2.77215	2.47940	2.47952	2.50640	2.50628
3	4	2.99360	2.99345	3.00000	2.99985	2.95280	2.95295	2.97200	2.97215	2.72940	2.72955	2.75640	2.75625
3 1/4	4	3.24360	3.24345	3.25000	3.24985	3.20280	3.20295	3.22200	3.22215	2.97940	2.97955	3.00640	3.00625
3 1/2	4	3.49360	3.49345	3.50000	3.49985	3.45280	3.45295	3.47200	3.47215	3.22940	3.22955	3.25640	3.25625
3 3/4	4	3.74360	3.74345	3.75000	3.74985	3.70280	3.70295	3.72200	3.72215	3.47940	3.47955	3.50640	3.50625
4	4	3.99360	3.99345	4.00000	3.99985	3.95280	3.95295	3.97200	3.97215	3.72940	3.72955	3.75640	3.75625

[1] Does not apply to threaded parts of unfinished hot-rolled material, class 2 fit. See table 16.

TABLE 21.—*Limiting dimensions of setting plug and thread ring gages and plain gages for screws of class 5 fit for threaded studs, American National coarse-thread series*

Limiting dimensions		Size (inches)												
		5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
		Threads per inch												
		18	16	14	13	12	11	10	9	8	7	7	6	6
"GO" THREAD GAGES FOR SCREWS														
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Max....	*Inch* 0.3176	*Inch* 0.3507	*Inch* 0.4438	*Inch* 0.5068	*Inch* 0.5697	*Inch* 0.6325	*Inch* 0.7579	*Inch* 0.8831	*Inch* 1.0082	*Inches* 1.1333	*Inches* 1.2583	*Inches* 1.3834	*Inches* 1.5089
	Min....	.3171	.3801	.4432	.5062	.5691	.6319	.7573	.8824	1.0075	1.1326	1.2576	1.3826	1.5081
Major diameter of truncated portion of truncated setting plug.	Max....	.3043	.3660	.4277	.4896	.5513	.6132	.7372	.8610	.9845	1.1080	1.2330	1.3548	1.4798
	Min....	.3038	.3654	.4271	.4890	.5507	.6126	.7366	.8603	.9841	1.1073	1.2323	1.3540	1.4790
Pitch diameter of setting plug or ring gage.....	Max W..	.2810	.3395	.3968	.4562	.5150	.5729	.6923	.8102	.9263	1.0398	1.1648	1.2743	1.3998
	Min W..	.2809	.3394	.39665	.45605	.5148	.5727	.6921	.8100	.9261	1.0396	1.1646	1.2741	1.3996
Minor diameter of ring gage.....	Max....	.2570	.3124	.3659	.4229	.4789	.5335	.6490	.7621	.8722	.9780	1.1030	1.2022	1.3277
	Min....	.2565	.3118	.3653	.4223	.4783	.5329	.6484	.7614	.8715	.9773	1.1623	1.2014	1.3269
"NOT GO" THREAD GAGES FOR SCREWS														
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Min....	.3171	.3801	.4432	.5062	.5691	.6319	.7573	.8824	1.0075	1.1326	1.2576	1.3826	1.5081
	Max....	.3176	.3807	.4438	.5068	.5697	.6325	.7579	.8831	1.0082	1.1333	1.2583	1.3834	1.5089
Major diameter of truncated portion of truncated setting plug.	Min....	.3031	.3644	.4253	.4870	.5485	.6096	.7327	.8552	.9772	1.0985	1.2235	1.3432	1.4687
	Max....	.3036	.3650	.4259	.4876	.5491	.6102	.7333	.8559	.9779	1.0992	1.2242	1.3440	1.4695
Pitch diameter of setting plug or ring gages for production and inspection.	Min W..	.2795	.3379	.3950	.4543	.5130	.5708	.6900	.8078	.9238	1.0373	1.1623	1.2718	1.3973
	Max W..	.2796	.3380	.39515	.45445	.5132	.5710	.6902	.8080	.9240	1.0375	1.1625	1.2720	1.3975
PLAIN GAGES FOR SCREWS														
"Go" gages for major diameter.....	Max....	.31250	.37500	.43750	.50000	.56250	.62500	.75000	.87500	1.00000	1.12500	1.25000	1.37500	1.50000
	Min....	.31243	.37493	.43743	.49993	.56243	.62493	.74993	.87491	.99991	1.12491	1.24991	1.37491	1.49991
"Not go" gages for major diameter.....	Min....	.30430	.36600	.42770	.48960	.55130	.61320	.73720	.86100	.98480	1.10800	1.23300	1.35480	1.47980
	Max....	.30437	.36607	.42777	.48967	.55137	.61327	.73727	.86109	.98489	1.10809	1.23309	1.35489	1.47989

TABLE 22.—*Limiting dimensions of thread plug gages and plain gages for nuts of class 5 fit for threaded studs, American National coarse-thread series*

Limiting dimensions	Size (inches)												
	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
	Threads per inch												
	18	16	14	13	12	11	10	9	8	7	7	6	6
"GO" THREAD GAGES FOR NUTS													
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage..... Min....	0.3125	0.3750	0.4375	0.5000	0.5625	0.6250	0.7500	0.8750	1.0000	1.1250	1.2500	1.3750	1.5000
Major diameter of plug gage..... Max....	.3130	.3756	.4381	.5006	.5631	.6256	.7506	.8757	1.0007	1.1257	1.2507	1.3758	1.5008
Pitch diameter of plug gage..... Min W..	.2764	.3344	.3911	.4500	.5084	.5660	.6850	.8028	.9188	1.0322	1.1572	1.2667	1.3917
Pitch diameter of plug gage..... Max W..	.2765	.3345	.39125	.45015	.5086	.5662	.6852	.8030	.9190	1.0324	1.1574	1.2669	1.3919
"NOT GO" THREAD GAOES FOR NUTS													
Major diameter of plug gage..... Max....	.3031	.3645	.4252	.4867	.5480	.6090	.7320	.8546	.9766	1.0978	1.2228	1.3426	1.4679
Major diameter of plug gage..... Min....	.3026	.3639	.4246	.4861	.5474	.6084	.7314	.8539	.9759	1.0971	1.2221	1.3418	1.4671
Pitch diameter of thread plug gages for production and inspection. Max W..	.2790	.3374	.3943	.4534	.5119	.5696	.6887	.8065	.9225	1.0359	1.1609	1.2704	1.3957
Pitch diameter of thread plug gages for production and inspection. Min W..	.2789	.3373	.39415	.45325	.5117	.5694	.6885	.8063	.9223	1.0357	1.1607	1.2702	1.3955
PLAIN GAGES FOR NUTS													
"Go" gages for minor diameter..... Min....	.26220	.31860	.37360	.43130	.48820	.54440	.66140	.77680	.89010	.99980	1.12480	1.22860	1.35360
"Go" gages for minor diameter..... Max....	.26227	.31867	.37367	.43137	.48827	.54447	.66147	.77687	.89019	.99989	1.12489	1.22869	1.35369
"Not go" gages for minor diameter..... Max....	.26820	.32540	.38130	.43960	.49720	.55420	.67220	.78880	.90360	1.01520	1.14020	1.24660	1.37160
"Not go" gages for minor diameter..... Min....	.26813	.32533	.38123	.43953	.49713	.55413	.67213	.78873	.90351	1.01511	1.14011	1.24651	1.37151

TABLE 23.—*Sizes of tap drills, American National coarse-thread series*[1]

Size of thread	Threads per inch	Minor diameter of nut			Stock drills and corresponding percentage of basic thread depth[2]		
		Basic	Maximum	Minimum	Nominal size	Diameter	Percentage of depth of basic thread
		Inch	*Inch*	*Inch*		*Inch*	
1.4	64	0.0527	0.0623	0.0561	1.45 mm	0.0571	78
					1.50 mm	.0591	68
					1.55 mm	.0610	59
2	56	.0628	.0737	.0667	#51	.0670	82
					#50	.0700	69
					#49	.0730	56
3	48	.0719	.0841	.0764	5/64 in	.0781	77
					#46	.0810	67
					2.10 mm	.0827	60
4	40	.0795	.0938	.0849	#44	.0860	80
					#43	.0890	71
					2.30 mm	.0906	66
					3/32 in	.0937	56
5	40	.0925	.1062	.0979	#39	.0995	79
					#38[3]	.1015	72
					2.60 mm	.1024	70
					#37	.1040	65
6	32	.0974	.1145	.1042	#36	.1065	78
					7/64 in	.1094	70
					#33	.1130	62
8	32	.1234	.1384	.1302	3.40 mm	.1339	74
					#29	.1360	69
					3.50 mm	.1378	65
10	24	.1359	.1559	.1449	#26	.1470	79
					#24	.1520	70
12	24	.1619	.1801	.1709	1 1/64 in	.1719	82
					#17	.1730	79
					#16	.1770	72
					#15	.1800	67
1/4	20	.1850	.2060	.1959	#9	.1960	83
					#8	.1990	79
					13/64 in	.2031	72
5/16	18	.2403	.2630	.2524	F	.2570	77
					G	.2610	71
3/8	16	.2938	.3184	.3073	5/16 in	.3125	77
					O	.3160	73
7/16	14	.3447	.3721	.3602	U	.3680	75
1/2	13	.4001	.4290	.4167	27/64 in	.4219	78
9/16	12	.4542	.4850	.4723	31/64 in	.4844	72
5/8	11	.5069	.5397	.5266	17/32 in	.5312	79
					13.5 mm	.5315	79
3/4	10	.6201	.6553	.6417	16.5 mm	.6496	77
7/8	9	.7307	.7689	.7547	49/64 in	.7656	76
					19.5 mm	.7677	74
1	8	.8376	.8795	.8647	22 mm	.8661	82
					7/8 in	.8750	77
1 1/8	7	.9394	.9858	.9704	25 mm	.9842	76
					63/64 in	.9844	76
1 1/4	7	1.0644	1.1108	1.0954	28 mm	1.1024	80
					1 7/64 in	1.1094	76
1 3/8	6	1.1585	1.2126	1.1946	30.5 mm	1.2008	80
					1 13/64 in	1.2031	79
1 1/2	6	1.2835	1.3376	1.3196	1 21/64 in	1.3281	79
1 3/4	5	1.4902	1.5551	1.5335	39 mm	1.5354	83
					1 35/64 in	1.5469	78
					39.5 mm	1.5551	75

See footnotes at end of table.

TABLE 23.—*Sizes of tap drills, American National coarse-thread series*[1]—Continued

Size of thread	Threads per inch	Minor diameter of nut			Stock drills and corresponding percentage of basic thread depth[2]		
		Basic	Maximum	Minimum	Nominal size	Diameter	Percentage of depth of basic thread
		Inch	*Inch*	*Inch*		*Inch*	
2	4½	1.7113	1.7835	1.7594	1 47/64 in.	1.7656	81
					45 mm.	1.7716	79
					1 25/32 in.	1.7812	76
2¼	4½	1.9613	2.0335	2.0094	2 1/64 in.	2.0156	81
					51.5 mm.	2.0276	77
					2 1/32 in.	2.0312	76
2½	4	2.1752	2.2564	2.2294	2 15/64 in.	2.2344	82
					57 mm.	2.2441	79
					2¼ in.	2.2500	77
2¾	4	2.4252	2.5064	2.4794	63 mm.	2.4803	83
					2 31/64 in.	2.4844	82
					63.5 mm.	2.5000	77
					2½ in.	2.5000	77
3	4	2.6752	2.7564	2.7294	2 47/64 in.	2.7344	82
					69.5 mm.	2.7362	81
					2¾ in.	2.7500	77
					70 mm.	2.7559	75
3¼	4	2.9252	3.0064	2.9794	2 63/64 in.	2.9844	82
					76 mm.	2.9921	79
					3.	3.0000	77
3½	4	3.1752	3.2564	3.2294	3¼ in.	3.2500	77
3¾	4	3.4252	3.5064	3.4794	3½ in.	3.5000	77

[1] Sizes of tap drills for class 5 fit are given in table 17.
[2] Drill sizes up to ½ inch are in agreement with A.S.A. B 5.12-1940, Twist Drills, Straight Shank, published by the A.S.M.E., 29 West 39th Street, New York, N. Y.
[3] This size is not included as standard in A.S.A. B 5.12-1940, but is listed in an appendix thereto.

3. AMERICAN NATIONAL FINE-THREAD SERIES

The American National fine-thread series, as specified in table 14, is recommended for general use in automotive and aircraft work, and where special conditions require a fine thread. The fine-thread series is composed of standards that have been found necessary, and consists of sizes taken from the standards of the Society of Automotive Engineers (S.A.E.) and the fine-thread series of the American Society of Mechanical Engineers (A.S.M.E.).

Threads of the American National fine-thread series are designated by the symbol NF. Example:

To specify a threaded part 1 inch diameter, 14 threads per inch, class 4 fit, mark..... *1"—14NF—4*

Limiting dimensions for the American National fine thread series, classes 1, 2, 3, 4, and 5, are given in tables 23 and 24. The limiting dimensions given for classes 4 and 5 do not include the complete range of sizes of this thread series. The limiting dimensions of thread gages are given in tables 26, 27, 28, 29, and 30; and of tap drill sizes in table 31.

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TABLE 24.—*Limiting dimensions and tolerances, classes 1, 2, 3, and 4 fits, American National fine-thread series*

Dimensions and tolerances	Machine screw number or nominal size													
	0	1	2	3	4	5	6	8	10	12	1/4	5/16	3/8	7/16
	Threads per inch													
	80	72	64	56	48	44	40	36	32	28	28	24	24	20
BOLTS AND SCREWS														
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
Class 1, major diameter: Max...	0.0593	0.0723	0.0853	0.0982	0.1111	0.1241	0.1370	0.1629	0.1889	0.2148	0.2488	0.3112	0.3737	0.4360
Class 1, major diameter: Min...	.0545	.0673	.0801	.0926	.1049	.1177	.1302	.1557	.1813	.2062	.2402	.3020	.3645	.4258
Class 1, major diameter: Tol...	.0048	.0050	.0052	.0056	.0062	.0064	.0068	.0072	.0076	.0086	.0086	.0092	.0092	.0102
Classes 2, 3, and 4, major diameter: Max...	.0600	.0730	.0860	.0990	.1120	.1250	.1380	.1640	.1900	.2160	.2500	.3125	.3750	.4375
Classes 2, 3, and 4, major diameter: Min...	.0566	.0694	.0822	.0950	.1076	.1204	.1332	.1590	.1846	.2098	.2438	.3059	.3684	.4303
Classes 2, 3, and 4, major diameter: Tol...	.0034	.0036	.0038	.0040	.0044	.0046	.0048	.0050	.0054	.0062	.0062	.0066	.0066	.0072
Class 1, minor diameter: Max[1]..	.0440	.0553	.0661	.0763	.0855	.0962	.1063	.1288	.1506	.1710	.2050	.2601	.3226	.3747
Classes 2, 3, and 4, minor diameter: Max[1]..	.0447	.0560	.0668	.0771	.0864	.0971	.1073	.1299	.1517	.1722	.2062	.2614	.3239	.3762
Class 1, pitch diameter: Max[3]..	.0512	.0633	.0752	.0866	.0976	.1093	.1208	.1449	.1686	.1916	.2256	.2841	.3466	.4035
Class 1, pitch diameter: Min...	.0488	.0608	.0726	.0838	.0945	.1061	.1174	.1413	.1648	.1873	.2213	.2795	.3420	.3984
Class 1, pitch diameter: Tol...	.0024	.0025	.0026	.0028	.0031	.0032	.0034	.0036	.0038	.0043	.0043	.0046	.0046	.0051
Class 2, pitch diameter: Max[3]..	.0519	.0640	.0759	.0874	.0985	.1102	.1218	.1460	.1697	.1928	.2268	.2854	.3479	.4050
Class 2, pitch diameter: Min...	.0502	.0622	.0740	.0854	.0963	.1079	.1194	.1435	.1670	.1897	.2237	.2821	.3446	.4014
Class 2, pitch diameter: Tol...	.0017	.0018	.0019	.0020	.0022	.0023	.0024	.0025	.0027	.0031	.0031	.0033	.0033	.0036
Class 3, pitch diameter: Max[3]..	.0519	.0640	.0759	.0874	.0985	.1102	.1218	.1460	.1697	.1928	.2268	.2854	.3479	.4050
Class 3, pitch diameter: Min...	.0506	.0627	.0745	.0859	.0969	.1086	.1201	.1442	.1678	.1906	.2246	.2830	.3455	.4024
Class 3, pitch diameter: Tol...	.0013	.0013	.0014	.0015	.0016	.0016	.0017	.0018	.0019	.0022	.0022	.0024	.0024	.0026
Class 4, pitch diameter: Max[3]..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2270	.2857	.3482	.4053
Class 4, pitch diameter: Min...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2259	.2845	.3470	.4040
Class 4, pitch diameter: Tol...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.0011	.0012	.0012	.0013
NUTS AND TAPPED HOLES														
Classes 1, 2, 3, and 4, major diameter... Min[2]..	.0600	.0730	.0860	.0990	.1120	.1250	.1380	.1640	.1900	.2160	.2500	.3125	.3750	.4375
Classes 1, 2, 3, and 4, minor diameter... Min...	.0465	.0580	.0691	.0797	.0894	.1004	.1109	.1339	.1562	.1773	.2113	.2674	.3299	.3834
Classes 1, 2, 3, and 4, minor diameter... Max...	.0514	.0634	.0746	.0856	.0960	.1068	.1179	.1402	.1624	.1835	.2173	.2739	.3364	.3906
Classes 1, 2, 3, and 4, minor diameter... Tol...	.0049	.0054	.0055	.0059	.0066	.0064	.0070	.0063	.0062	.0062	.0060	.0065	.0065	.0072
Classes 1, 2, 3, and 4, pitch diameter... Min[3]..	.0519	.0640	.0759	.0874	.0985	.1102	.1218	.1460	.1697	.1928	.2268	.2854	.3479	.4050
Class 1, pitch diameter: Max...	.0543	.0665	.0785	.0902	.1016	.1134	.1252	.1496	.1735	.1971	.2311	.2900	.3525	.4101
Class 1, pitch diameter: Tol...	.0024	.0025	.0026	.0028	.0031	.0032	.0034	.0036	.0038	.0043	.0043	.0046	.0046	.0051
Class 2, pitch diameter: Max...	.0536	.0658	.0778	.0894	.1007	.1125	.1242	.1485	.1724	.1959	.2299	.2887	.3512	.4086
Class 2, pitch diameter: Tol...	.0017	.0018	.0019	.0020	.0022	.0023	.0024	.0025	.0027	.0031	.0031	.0033	.0033	.0036
Class 3, pitch diameter: Max...	.0532	.0653	.0773	.0889	.1001	.1118	.1235	.1478	.1716	.1950	.2290	.2878	.3503	.4076
Class 3, pitch diameter: Tol...	.0013	.0013	.0014	.0015	.0016	.0016	.0017	.0018	.0019	.0022	.0022	.0024	.0024	.0026
Class 4, pitch diameter: Max...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2279	.2866	.3491	.4063
Class 4, pitch diameter: Tol...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.0011	.0012	.0012	.0013

Dimensions and tolerances	Size (inches)									
	½	9/16	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½
	Threads per inch									
	20	18	18	16	14	14	12	12	12	12
BOLTS AND SCREWS										
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*
Class 1, major diameter — Max...	0.4985	0.5609	0.6234	0.7482	0.8729	0.9979	1.1226	1.2476	1.3726	1.4976
Class 1, major diameter — Min...	.4883	.5495	.6120	.7356	.8589	.9839	1.1068	1.2318	1.3568	1.4818
Class 1, major diameter — Tol...	.0102	.0114	.0114	.0126	.0140	.0140	.0158	.0158	.0158	.0158
Classes 2, 3, and 4, major diameter — Max...	.5000	.5625	.6250	.7500	.8750	1.0000	1.1250	1.2500	1.3750	1.5000
Classes 2, 3, and 4, major diameter — Min...	.4928	.5543	.6168	.7410	.8652	.9902	1.1138	1.2388	1.3638	1.4888
Classes 2, 3, and 4, major diameter — Tol...	.0072	.0082	.0082	.0090	.0098	.0098	.0112	.0112	.0112	.0112
Class 1, minor diameter — Max[1]..	.4372	.4927	.5552	.6715	.7853	.9103	1.0204	1.1454	1.2704	1.3954
Classes 2, 3, and 4, minor diameter — Max[1]..	.4387	.4943	.5568	.6733	.7874	.9124	1.0228	1.1478	1.2728	1.3978
Class 1, pitch diameter — Max[3]..	.4660	.5248	.5873	.7076	.8265	.9515	1.0685	1.1935	1.3185	1.4435
Class 1, pitch diameter — Min...	.4609	.5191	.5816	.7013	.8195	.9445	1.0606	1.1856	1.3106	1.4356
Class 1, pitch diameter — Tol...	.0051	.0057	.0057	.0063	.0070	.0070	.0079	.0079	.0079	.0079
Class 2, pitch diameter — Max[3]..	.4675	.5264	.5889	.7094	.8286	.9536	1.0709	1.1959	1.3209	1.4459
Class 2, pitch diameter — Min...	.4639	.5223	.5848	.7049	.8237	.9487	1.0653	1.1903	1.3153	1.4403
Class 2, pitch diameter — Tol...	.0036	.0041	.0041	.0045	.0049	.0049	.0056	.0056	.0056	.0056
Class 3, pitch diameter — Max[3]..	.4675	.5264	.5889	.7094	.8286	.9536	1.0709	1.1959	1.3209	1.4459
Class 3, pitch diameter — Min...	.4649	.5234	.5859	.7062	.8250	.9500	1.0669	1.1919	1.3169	1.4419
Class 3, pitch diameter — Tol...	.0026	.0030	.0030	.0032	.0036	.0036	.0040	.0040	.0040	.0040
Class 4, pitch diameter — Max[3]..	.4678	.5267	.5892	.7098	.8290	.9540	1.0714	1.1964	1.3214	1.4464
Class 4, pitch diameter — Min...	.4665	.5252	.5877	.7082	.8272	.9522	1.0694	1.1944	1.3194	1.4444
Class 4, pitch diameter — Tol...	.0013	.0015	.0015	.0016	.0018	.0018	.0020	.0020	.0020	.0020
NUTS AND TAPPED HOLES										
Classes 1, 2, 3, and 4, major diameter — Min[2]..	.5000	.5625	.6250	.7500	.8750	1.0000	1.1250	1.2500	1.3750	1.5000
Classes 1, 2, 3, and 4, minor diameter — Min...	.4459	.5024	.5649	.6823	.7977	.9227	1.0348	1.1598	1.2848	1.4098
Classes 1, 2, 3, and 4, minor diameter — Max...	.4531	.5100	.5725	.6903	.8062	.9312	1.0438	1.1688	1.2938	1.4188
Classes 1, 2, 3, and 4, minor diameter — Tol...	.0072	.0076	.0076	.0080	.0085	.0085	.0090	.0090	.0090	.0090
Classes 1, 2, 3, and 4, pitch diameter — Min[3]..	.4675	.5264	.5889	.7094	.8286	.9536	1.0709	1.1959	1.3209	1.4459
Class 1, pitch diameter — Max...	.4726	.5321	.5946	.7157	.8356	.9606	1.0788	1.2038	1.3288	1.4538
Class 1, pitch diameter — Tol...	.0051	.0057	.0057	.0063	.0070	.0070	.0079	.0079	.0079	.0079
Class 2, pitch diameter — Max...	.4711	.5305	.5930	.7139	.8335	.9585	1.0765	1.2015	1.3265	1.4515
Class 2, pitch diameter — Tol...	.0036	.0041	.0041	.0045	.0049	.0049	.0056	.0056	.0056	.0056
Class 3, pitch diameter — Max...	.4701	.5294	.5919	.7126	.8322	.9572	1.0749	1.1999	1.3249	1.4499
Class 3, pitch diameter — Tol...	.0026	.0030	.0030	.0032	.0036	.0036	.0040	.0040	.0040	.0040
Class 4, pitch diameter — Max...	.4688	.5279	.5904	.7110	.8304	.9554	1.0729	1.1979	1.3229	1.4479
Class 4, pitch diameter — Tol...	.0013	.0015	.0015	.0016	.0018	.0018	.0020	.0020	.0020	.0020

[1] Dimensions given for the maximum minor diameter of the screw are figured to the intersection of the worn tool arc with a center line through crest and root. The minimum minor diameter of the screw shall be that corresponding to a flat at the minor diameter of the minimum screw equal to $\frac{1}{8} \times p$, and may be determined by subtracting the basic thread depth, h (or $0.6495p$), from the minimum pitch diameter of the screw. [2] Dimensions for the minimum major diameter of the nut correspond to the basic flat ($\frac{1}{8} \times p$) and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the nut shall be that corresponding to a flat at the major diameter of the maximum nut equal to $\frac{1}{24} \times p$, and may be determined by adding $1\frac{2}{3} \times h$ (or $0.7939p$) to the maximum pitch diameter of the nut. [3] These dimensions are the maximum metal or "go" size, and are those which should be placed on the component drawing with the tolerances.

TABLE 25.—*Limiting dimensions, class 5 fit, American National fine-thread series, steel studs set in hard materials (cast iron, semisteel, bronze, etc.)*

Sizes	Threads per inch	Stud sizes					Tapped-hole sizes					Recommended tap drill size		Approximate torque at full engagement of $1\frac{1}{2}D$	
		Major diameter		Pitch diameter		Minor diameter	Minor diameter		Pitch diameter		Major diameter				
		Maximum	Minimum	Maximum	Minimum	Maximum[1]	Minimum	Maximum	Minimum	Maximum	Minimum[2]	Nominal size	Diameter	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*in.-lb*	*in.-lb*
¼	28	0.2500	0.2438	0.2307	0.2296	0.2101	0.2167	0.2206	0.2268	0.2290	0.2500	0.2187	0.2187	140	50
5/16	24	.3125	.3059	.2896	.2884	.2655	.2743	.2788	.2854	.2878	.3125	.2770	.2770	230	80
3/8	24	.3750	.3684	.3523	.3511	.3282	.3368	.3413	.3479	.3503	.3750	.3390	.3390	410	145
7/16	20	.4375	.4303	.4097	.4084	.3808	.3924	.3978	.4050	.4076	.4375	.3970	.3970	540	195
½	20	.5000	.4928	.4725	.4712	.4436	.4549	.4603	.4675	.4701	.5000	.....	.4576	810	320
9/16	18	.5625	.5543	.5320	.5305	.4999	.5122	.5182	.5264	.5294	.5625	33/64	.5156	1,040	410
5/8	18	.6250	.6168	.5945	.5930	.5624	.5747	.5807	.5889	.5919	.6250	37/64	.5781	1,430	540
¾	16	.7500	.7410	.7153	.7137	.6792	.6936	.7004	.7094	.7126	.7500	.....	.6970	2,200	805
7/8	14	.8750	.8652	.8351	.8333	.7939	.8111	.8188	.8286	.8322	.8750	13/16	.8125	3,070	1,110
1	14	1.0000	.9902	.9605	.9587	.9193	.9361	.9438	.9536	.9572	1.0000	15/16	.9375	4,590	1,820
1⅛	12	1.1250	1.1138	1.0784	1.0764	1.0303	1.0507	1.0597	1.0709	1.0749	1.1250	.....	1.0552	5,620	2,260
1¼	12	1.2500	1.2388	1.2031	1.2011	1.1550	1.1757	1.1847	1.1959	1.1996	1.2500	30.0 mm	1.1811	6,960	2,960
1⅜	12	1.3750	1.3638	1.3276	1.3256	1.2795	1.3007	1.3097	1.3209	1.3241	1.3750	.....	1.3052	8,440	3,770
1½	12	1.5000	1.4888	1.4521	1.4501	1.4040	1.4257	1.4347	1.4459	1.4486	1.5000	.....	1.4302	10,070	4,710

[1]Dimensions given for the maximum minor diameter of the screw are figured to the intersection of the worn tool arc with a center line through crest and root. The minimum minor diameter of the screw shall be that corresponding to a flat at the minor diameter of the minimum screw equal to $\frac{1}{8} \times p$, and may be determined by subtracting the basic thread depth, h (or $0.6495p$), from the minimum pitch diameter of the screw.

[2]Dimensions for the minimum major diameter of the tapped hole correspond to the basic flat ($\frac{1}{8} \times p$) and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the tapped hole shall be that corresponding to a flat at the major diameter of the maximum tapped hole equal to $\frac{1}{24} \times p$, and may be determined by adding $1\frac{5}{6} \times h$ (or $0.7939p$) to the maximum pitch diameter of the nut.

TABLE 26.—*Limiting dimensions of setting plug and thread ring gages for screws of classes 1, 2, 3, and 4 fits, American National fine-thread series*

Limiting dimensions			Machine screw number or nominal size											
			0	1	2	3	4	5	6	8	10	12	¼	5/16
			Threads per inch											
			80	72	64	56	48	44	40	36	32	28	28	24
"GO" GAGES FOR SCREWS			*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Class 1..	Max....	0.0596	0.0726	0.0857	0.0986	0.1115	0.1245	0.1374	0.1633	0.1894	0.2153	0.2493	0.3117
		Min....	.0593	.0723	.0853	.0982	.1111	.1241	.1370	.1629	.1889	.2148	.2488	.3112
	Classes 2 and 3.	Max....	.0603	.0733	.0864	.0994	.1124	.1254	.1384	.1644	.1905	.2165	.2505	.3130
		Min....	.0600	.0730	.0860	.0990	.1120	.1250	.1380	.1640	.1900	.2160	.2500	.3125
	Class 4..	Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2507	.3133
		Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2502	.3128
Major diameter of truncated portion of truncated setting plug.	Class 1..	Max....	.0545	.0673	.0801	.0926	.1049	.1177	.1302	.1557	.1813	.2062	.2402	.3020
		Min....	.0542	.0670	.0797	.0922	.1045	.1173	.1298	.1553	.1808	.2057	.2397	.3015
	Classes 2, 3 and 4.	Max....	.0566	.0694	.0822	.0950	.1076	.1204	.1332	.1590	.1846	.2098	.2438	.3059
		Min....	.0563	.0691	.0818	.0946	.1072	.1200	.1328	.1586	.1841	.2093	.2433	.3054
Pitch diameter of setting plug or ring gage.	Class 1..	Max Y..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2254	.2839
		Min Y..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2251	.2836
		Max X..	.0512	.0633	.0752	.0866	.0976	.1093	.1208	.1449	.1686	.1916	.2256	.2841
		Min X..	.0510	.0631	.0750	.0864	.0974	.1091	.1206	.1447	.1683	.1913	.2253	.2838
	Classes 2 and 3.	Max Y..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2266	.2852
		Min Y..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2263	.2849
		Max X..	.0519	.0640	.0759	.0874	.0985	.1102	.1218	.1460	.1697	.1928	.2268	.2854
		Min X..	.0517	.0638	.0757	.0872	.0983	.1100	.1216	.1458	.1694	.1925	.2265	.2851
	Class 4..	Max W..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2270	.2857
		Min W..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2269	.2856
Minor diameter of ring gage.	Classes 1, 2, 3, and 4.	Max....	.0465	.0580	.0691	.0797	.0894	.1004	.1109	.1339	.1562	.1773	.2113	.2674
		Min....	.0462	.0577	.0687	.0793	.0890	.1000	.1105	.1335	.1557	.1768	.2108	.2669
"NOT GO" GAGES FOR Screws														
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Class 1..	Min....	.0593	.0723	.0853	.0982	.1111	.1241	.1370	.1629	.1889	.2148	.2488	.3112
		Max....	.0596	.0726	.0857	.0986	.1115	.1245	.1374	.1633	.1894	.2153	.2493	.3117
	Classes 2 and 3.	Min....	.0600	.0730	.0860	.0990	.1120	.1250	.1380	.1640	.1900	.2160	.2500	.3125
		Max....	.0603	.0733	.0864	.0994	.1124	.1254	.1384	.1644	.1905	.2165	.2505	.3130
	Class 4..	Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2502	.3128
		Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2507	.3133
Major diameter of truncated portion of truncated setting plug.	Class 1..	Min....	.0539	.0665	.0790	.0911	.1031	.1155	.1278	.1529	.1779	.2023	.2363	.2970
		Max....	.0542	.0668	.0794	.0915	.1035	.1159	.1282	.1533	.1783	.2028	.2368	.2975
	Class 2..	Min....	.0553	.0679	.0804	.0927	.1049	.1173	.1298	.1551	.1801	.2047	.2387	.2996
		Max....	.0556	.0682	.0808	.0931	.1053	.1177	.1302	.1555	.1805	.2052	.2392	.3001
	Class 3..	Min....	.0557	.0684	.0809	.0932	.1055	.1180	.1305	.1558	.1809	.2056	.2396	.3005
		Max....	.0560	.0687	.0813	.0936	.1059	.1184	.1309	.1562	.1813	.2061	.2401	.3010
	Class 4..	Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2409	.3020
		Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2414	.3025
Pitch diameter of setting plug and ring gages for production and inspection.	Class 1..	Min....	.0488	.0608	.0726	.0838	.0945	.1061	.1174	.1413	.1648	.1873	.2213	.2795
		Max....	.0490	.0610	.0728	.0840	.0947	.1063	.1176	.1415	.1651	.1876	.2216	.2798
	Class 2..	Min....	.0502	.0622	.0740	.0854	.0963	.1079	.1194	.1435	.1670	.1897	.2237	.2821
		Max....	.0504	.0624	.0742	.0856	.0965	.1081	.1196	.1437	.1673	.1900	.2240	.2824
	Class 3..	Min....	.0506	.0627	.0745	.0859	.0969	.1086	.1201	.1442	.1678	.1906	.2246	.2830
		Max....	.0508	.0629	.0747	.0861	.0971	.1088	.1203	.1444	.1681	.1909	.2249	.2833
	Class 4..	Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2259	.2845
		Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2260	.2846
(OPTIONAL)														
Pitch diameter of setting plug and ring gages for inspection. (See par. 6, p. 31.)	Class 1..	Min....	.0486	.0606	.0724	.0836	.0943	.1059	.1172	.1411	.1645	.1870	.2210	.2792
		Max....	.0488	.0608	.0726	.0838	.0945	.1061	.1174	.1413	.1648	.1873	.2213	.2795
	Class 2..	Min....	.0500	.0620	.0738	.0852	.0961	.1077	.1192	.1433	.1667	.1894	.2234	.2818
		Max....	.0502	.0622	.0740	.0854	.0963	.1079	.1194	.1435	.1670	.1897	.2237	.2821
	Class 3..	Min....	.0504	.0625	.0743	.0857	.0967	.1084	.1199	.1440	.1675	.1903	.2243	.2827
		Max....	.0506	.0627	.0745	.0859	.0969	.1086	.1201	.1442	.1678	.1906	.2246	.2830
	Class 4..	Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2258	.2844
		Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2259	.2845
Minor diameter of ring gage.	Class 1..	Min....	.0461	.0578	.0692	.0799	.0900	.1012	.1120	.1353	.1580	.1796	.2136	.2705
		Max....	.0464	.0581	.0696	.0803	.0904	.1016	.1124	.1357	.1585	.1801	.2141	.2710
	Class 2..	Min....	.0475	.0592	.0706	.0815	.0918	.1030	.1140	.1375	.1602	.1820	.2160	.2731
		Max....	.0478	.0595	.0710	.0819	.0922	.1034	.1144	.1379	.1607	.1825	.2165	.2736
	Class 3..	Min....	.0479	.0597	.0711	.0820	.0924	.1037	.1147	.1382	.1610	.1829	.2169	.2740
		Max....	.0482	.0600	.0715	.0824	.0928	.1041	.1151	.1386	.1615	.1834	.2174	.2745
	Class 4..	Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2182	.2755
		Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2187	.2760

TABLE 26.—*Limiting dimensions of setting plug and thread ring gages for screws of classes 1, 2, 3, and 4 fits, American National fine-thread series*—Continued

Limiting dimensions			Size (inches)										
			3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
			Threads per inch											
			24	20	20	18	18	16	14	14	12	12	12	12
"GO" GAGES FOR SCREWS			*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Class 1..	Max....	0.3742	0.4365	0.4990	0.5614	0.6239	0.7488	0.8735	0.9985	1.1232	1.2482	1.3732	1.4982
		Min....	.3737	.4360	.4985	.5609	.6234	.7482	.8729	.9979	1.1226	1.2476	1.3726	1.4976
	Classes 2 and 3.	Max....	.3755	.4380	.5005	.5630	.6255	.7506	.8756	1.0006	1.1256	1.2506	1.3756	1.5006
		Min....	.3750	.4375	.5000	.5625	.6250	.7500	.8750	1.0000	1.1250	1.2500	1.3750	1.5000
	Class 4..	Max....	.3758	.4383	.5008	.5633	.6258	.7510	.8760	1.0010	1.1261	1.2511	1.3761	1.5011
		Min....	.3753	.4378	.5003	.5628	.6253	.7504	.8754	1.0004	1.1255	1.2505	1.3755	1.5005
Major diameter of truncated portion of truncated setting plug.	Class 1..	Max....	.3645	.4258	.4883	.5495	.6120	.7356	.8589	.9839	1.1068	1.2318	1.3568	1.4818
		Min....	.3640	.4253	.4878	.5490	.6115	.7350	.8583	.9833	1.1062	1.2312	1.3562	1.4812
	Classes 2, 3, and 4.	Max....	.3684	.4303	.4928	.5543	.6168	.7410	.8652	.9902	1.1138	1.2388	1.3638	1.4888
		Min....	.3679	.4298	.4923	.5538	.6163	.7404	.8646	.9896	1.1132	1.2882	1.3632	1.4882
Pitch diameter of setting plug or ring gage.	Class 1..	Max Y..	.3464	.4033	.4658	.5246	.5871	.7074	.8263	.9513	1.0683	1.1933	1.3183	1.4433
		Min Y..	.3461	.4030	.4655	.5243	.5868	.7070	.8259	.9509	1.0679	1.1929	1.3179	1.4429
		Max X..	.3466	.4035	.4660	.5248	.5873	.7076	.8265	.9515	1.0685	1.1935	1.3185	1.4435
		Min X..	.3463	.4032	.4657	.5245	.5870	.7073	.8262	.9512	1.0682	1.1932	1.3182	1.4432
	Classes 2 and 3.	Max Y..	.3477	.4048	.4673	.5262	.5887	.7092	.8284	.9534	1.0707	1.1957	1.3207	1.4457
		Min Y..	.3474	.4045	.4670	.5259	.5884	.7088	.8280	.9530	1.0703	1.1953	1.3203	1.4453
		Max X..	.3479	.4050	.4675	.5264	.5889	.7094	.8286	.9536	1.0709	1.1959	1.3209	1.4459
		Min X..	.3476	.4047	.4672	.5261	.5886	.7091	.8283	.9533	1.0706	1.1956	1.3206	1.4456
	Class 4..	Max W..	.3482	.4053	.4678	.5267	.5892	.7098	.8290	.9540	1.0714	1.1964	1.3214	1.4464
		Min W..	.3481	.4052	.4677	.52655	.58905	.7096	.8288	.9538	1.0712	1.1962	1.3212	1.4462
Minor diameter of ring gage.	Classes 1, 2, 3, and 4.	Max....	.3299	.3834	.4459	.5024	.5649	.6823	.7977	.9227	1.0348	1.1598	1.2848	1.4098
		Min....	.3294	.3829	.4454	.5019	.5644	.6817	.7971	.9221	1.0342	1.1592	1.2842	1.4092
"NOT GO" GAGES FOR SCREWS														
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Class 1..	Min....	.3737	.4360	.4985	.5609	.6234	.7482	.8729	.9979	1.1226	1.2476	1.3726	1.4976
		Max....	.3742	.4365	.4990	.5614	.6239	.7488	.8735	.9985	1.1232	1.2482	1.3732	1.4982
	Classes 2 and 3.	Min....	.3750	.4375	.5000	.5625	.6250	.7500	.8750	1.0000	1.1250	1.2500	1.3750	1.5000
		Max....	.3755	.4380	.5005	.5630	.6255	.7506	.8756	1.0006	1.1256	1.2506	1.3756	1.5006
	Class 4..	Min....	.3753	.4378	.5003	.5628	.6253	.7504	.8754	1.0004	1.1255	1.2505	1.3755	1.5005
		Max....	.3758	.4383	.5008	.5633	.6258	.7510	.8760	1.0010	1.1261	1.2511	1.3761	1.5011
Major diameter of truncated portion of truncated setting plug.	Class 1..	Min....	.3595	.4196	.4821	.5427	.6052	.7278	.8498	0.9748	1.0961	1.2211	1.3461	1.4711
		Max....	.3600	.4201	.4826	.5432	.6057	.7284	.8504	.9754	1.0967	1.2217	1.3467	1.4717
	Class 2..	Min....	.3621	.4226	.4851	.5459	.6084	.7314	.8540	.9790	1.0008	1.2258	1.3508	1.4758
		Max....	.3626	.4231	.4856	.5464	.6089	.7320	.8546	.9796	1.1014	1.2264	1.3514	1.4764
	Class 3..	Min....	.3630	.4236	.4861	.5470	.6095	.7327	.8553	.9803	1.1024	1.2274	1.3524	1.4774
		Max....	.3635	.4241	.4866	.5475	.6100	.7333	.8559	.9809	1.1030	1.2280	1.3530	1.4780
	Class 4..	Min....	.3645	.4252	.4877	.5488	.6113	.7347	.8575	.9825	1.1049	1.2299	1.3549	1.4799
		Max....	.3650	.4257	.4882	.5493	.6118	.7353	.8581	.9831	1.1055	1.2305	1.3555	1.4805
Pitch diameter of setting plug and ring gages for production and inspection.	Class 1..	Min....	.3420	.3984	.4609	.5191	.5816	.7013	.8195	.9445	1.0606	1.1856	1.3106	1.4356
		Max....	.3423	.3987	.4612	.5194	.5819	.7016	.8198	.9448	1.0609	1.1859	1.3109	1.4359
	Class 2..	Min....	.3446	.4014	.4639	.5223	.5848	.7049	.8237	.9487	1.0653	1.1903	1.3153	1.4403
		Max....	.3449	.4017	.4642	.5226	.5851	.7052	.8240	.9490	1.0656	1.1906	1.3156	1.4406
	Class 3..	Min....	.3455	.4024	.4649	.5234	.5859	.7062	.8250	.9500	1.0669	1.1919	1.3169	1.4419
		Max....	.3458	.4027	.4652	.5237	.5862	.7065	.8253	.9503	1.0672	1.1922	1.3172	1.4422
	Class 4..	Min....	.3470	.4040	.4665	.5252	.5877	.7082	.8272	.9522	1.0694	1.1944	1.3194	1.4444
		Max....	.3471	.4041	.4666	.52535	.58785	.7084	.8274	.9524	1.0696	1.1946	1.3196	1.4446
(OPTIONAL)														
Pitch diameter of setting plug and ring gages for inspection. (See par. 6, p. 31.)	Class 1..	Min....	.3417	.3981	.4606	.5188	.5813	.7010	.8192	.9442	1.0603	1.1853	1.3103	1.4353
		Max....	.3420	.3984	.4609	.5191	.5816	.7013	.8195	.9445	1.0606	1.1856	1.3106	1.4356
	Class 2..	Min....	.3443	.4011	.4636	.5220	.5845	.7046	.8234	.9484	1.0650	1.1900	1.3150	1.4400
		Max....	.3446	.4014	.4639	.5223	.5848	.7049	.8237	.9487	1.0653	1.1903	1.3153	1.4403
	Class 3..	Min....	.3452	.4021	.4646	.5231	.5856	.7059	.8247	.9497	1.0666	1.1916	1.3166	1.4416
		Max....	.3455	.4024	.4649	.5234	.5859	.7062	.8250	.9500	1.0669	1.1919	1.3169	1.4419
	Class 4..	Min....	.3469	.4039	.4664	.52505	.58755	.7080	.8270	.9520	1.0692	1.1942	1.3192	1.4442
		Max....	.3470	.4040	.4665	.5252	.5877	.7082	.8272	.9522	1.0694	1.1944	1.3194	1.4444
Minor diameter of ring gage.	Class 1..	Min....	.3330	.3876	.4501	.5071	.5696	.6878	.8040	.9290	1.0426	1.1676	1.2926	1.4176
		Max....	.3335	.3881	.4506	.5076	.5701	.6884	.8046	.9296	1.0432	1.1682	1.2932	1.4182
	Class 2..	Min....	.3356	.3906	.4531	.5103	.5728	.6914	.8082	.9332	1.0473	1.1723	1.2973	1.4223
		Max....	.3361	.3911	.4536	.5108	.5733	.6920	.8088	.9338	1.0479	1.1729	1.2979	1.4229
	Class 3..	Min....	.3365	.3916	.4541	.5114	.5739	.6927	.8095	.9345	1.0489	1.1739	1.2989	1.4239
		Max....	.3370	.3921	.4546	.5119	.5744	.6933	.8101	.9351	1.0495	1.1745	1.2995	1.4245
	Class 4..	Min....	.3380	.3932	.4557	.5132	.5757	.6947	.8117	.9367	1.0514	1.1764	1.3014	1.4264
		Max....	.3385	.3937	.4562	.5137	.5762	.6953	.8123	.9373	1.0520	1.1770	1.3020	1.4270

TABLE 27.—*Limiting dimensions of thread plug gages for nuts of classes 1, 2, 3, and 4 fits, American National fine-thread series*

Limiting dimensions			Machine screw number or nominal size										
			0	1	2	3	4	5	6	8	10	12	1/4	5/16
			Threads per inch											
			80	72	64	56	48	44	40	36	32	28	28	24
"GO" GAGES FOR NUTS			*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
Major diameter of plug gage.	Classes 1, 2, 3, and 4.	Min....	0.0600	0.0730	0.0860	0.0990	0.1120	0.1250	0.1380	0.1640	0.1900	0.2160	0.2500	0.3125
		Max....	.0603	.0733	.0864	.0994	.1124	.1254	.1384	.1644	.1905	.2165	.2505	.3130
Pitch diameter of plug gage.	Classes 1, 2, and 3.	Min Y..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2270	.2856
		Max Y..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2273	.2859
		Min X..	.0519	.0640	.0759	.0874	.0985	.1102	.1218	.1460	.1697	.1928	.2268	.2854
		Max X..	.0521	.0642	.0761	.0876	.0987	.1104	.1220	.1462	.1700	.1931	.2271	.2857
	Class 4..	Min W..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2268	.2854
		Max W..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2269	.2855
"NOT GO" GAGES FOR NUTS														
Major diameter of plug gage.	Class 1..	Max....	.0597	.0725	.0853	.0979	.1106	.1232	.1360	.1616	.1870	.2126	.2466	.3080
		Min....	.0594	.0722	.0849	.0975	.1102	.1228	.1356	.1612	.1865	.2121	.2461	.3075
	Class 2..	Max....	.0590	.0718	.0846	.0971	.1097	.1223	.1350	.1605	.1859	.2114	.2454	.3067
		Min....	.0587	.0715	.0842	.0967	.1093	.1219	.1346	.1601	.1854	.2109	.2449	.3062
	Class 3..	Max....	.0586	.0713	.0841	.0966	.1091	.1216	.1343	.1598	.1851	.2105	.2445	.3058
		Min....	.0583	.0710	.0837	.0962	.1087	.1212	.1339	.1594	.1846	.2100	.2440	.3053
	Class 4..	Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2434	.3046
		Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2429	.3041
Pitch diameter of thread plug gages for production and inspection.	Class 1..	Max....	.0543	.0665	.0785	.0902	.1016	.1134	.1252	.1496	.1735	.1971	.2311	.2900
		Min....	.0541	.0663	.0783	.0900	.1014	.1132	.1250	.1494	.1732	.1968	.2308	.2897
	Class 2..	Max....	.0536	.0658	.0778	.0894	.1007	.1125	.1242	.1485	.1724	.1959	.2299	.2887
		Min....	.0534	.0656	.0776	.0892	.1005	.1123	.1240	.1483	.1721	.1956	.2296	.2884
	Class 3..	Max....	.0532	.0653	.0773	.0889	.1001	.1118	.1235	.1478	.1716	.1950	.2290	.2878
		Min....	.0530	.0651	.0771	.0887	.0999	.1116	.1233	.1476	.1713	.1947	.2287	.2875
	Class 4..	Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2279	.2866
		Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2278	.2865
Pitch diameter of thread plug gages for inspection (see par. 6, p. 31).	Class 1..	Max....	.0545	.0667	.0787	.0904	.1018	.1136	.1254	.1498	.1738	.1974	.2314	.2903
		Min....	.0543	.0665	.0785	.0902	.1016	.1134	.1252	.1496	.1735	.1971	.2311	.2900
	Class 2..	Max....	.0538	.0660	.0780	.0896	.1009	.1127	.1244	.1487	.1727	.1962	.2302	.2890
		Min....	.0536	.0658	.0778	.0894	.1007	.1125	.1242	.1485	.1724	.1959	.2299	.2887
	Class 3..	Max....	.0534	.0655	.0775	.0891	.1003	.1120	.1237	.1480	.1719	.1953	.2293	.2881
		Min....	.0532	.0653	.0773	.0889	.1001	.1118	.1235	.1478	.1716	.1950	.2290	.2878
	Class 4..	Max....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2280	.2867
		Min....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.2279	.2866

TABLE 27.—*Limiting dimensions of thread plug gages for nuts of classes 1, 2, 3, and 4 fits, American National fine-thread series*—Continued

Limiting dimensions			Size (inches)										
			3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
			Threads per inch											
			24	20	20	18	18	16	14	14	12	12	12	12
"GO" GAGES FOR NUTS			*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage.	Classes 1, 2, 3 and 4.	Min....	0.3750	0.4375	0.5000	0.5625	0.6250	0.7500	0.8750	1.0000	1.1250	1.2500	1.3750	1.5000
		Max....	.3755	.4380	.5005	.5630	.6255	.7506	.8756	1.0006	1.1256	1.2506	1.3756	1.5006
Pitch diameter of plug gage.	Classes 1, 2 and 3.	Min Y..	.3481	.4052	.4677	.5266	.5891	.7096	.8288	.9538	1.0711	1.1961	1.3211	1.4461
		Max Y..	.3484	.4055	.4680	.5269	.5894	.7100	.8292	.9542	1.0715	1.1965	1.3215	1.4465
		Min X..	.3479	.4050	.4675	.5264	.5889	.7094	.8286	.9536	1.0709	1.1959	1.3209	1.4459
		Max X..	.3482	.4053	.4678	.5267	.5892	.7097	.8289	.9539	1.0712	1.1962	1.3212	1.4462
	Class 4..	Min W..	.3479	.4050	.4675	.5264	.5889	.7094	.8286	.9536	1.0709	1.1959	1.3209	1.4459
		Max W..	.3480	.4051	.4676	.52655	.58905	.7096	.8288	.9538	1.0711	1.1961	1.3211	1.4461
"NOT GO" GAGES FOR NUTS														
Major diameter of plug gage.	Class 1..	Max....	.3705	.4318	.4943	.5562	.6187	.7428	.8665	.9915	1.1149	1.2399	1.3649	1.4899
		Min....	.3700	.4313	.4938	.5557	.6182	.7422	.8659	.9909	1.1143	1.2393	1.3643	1.4893
	Class 2..	Max....	.3692	.4303	.4928	.5546	.6171	.7410	.8644	.9894	1.1126	1.2376	1.3626	1.4876
		Min....	.3687	.4298	.4923	.5541	.6166	.7404	.8638	.9888	1.1120	1.2370	1.3620	1.4870
	Class 3..	Max....	.3683	.4293	.4918	.5535	.6160	.7397	.8631	.9881	1.1110	1.2360	1.3610	1.4860
		Min....	.3678	.4288	.4913	.5530	.6155	.7391	.8625	.9875	1.1104	1.2354	1.3604	1.4854
	Class 4..	Max....	.3671	.4280	.4905	.5520	.6145	.7381	.8613	.9863	1.1090	1.2340	1.3590	1.4840
		Min....	.3666	.4275	.4900	.5515	.6140	.7375	.8607	.9857	1.1084	1.2334	1.3584	1.4834
Pitch diameter of thread plug gages for production and inspection.	Class 1..	Max....	.3525	.4101	.4726	.5321	.5946	.7157	.8356	.9606	1.0788	1.2038	1.3288	1.4538
		Min....	.3522	.4098	.4723	.5318	.5943	.7154	.8353	.9603	1.0785	1.2035	1.3285	1.4535
	Class 2..	Max....	.3512	.4086	.4711	.5305	.5930	.7139	.8335	.9585	1.0765	1.2015	1.3265	1.4515
		Min....	.3509	.4083	.4708	.5302	.5927	.7136	.8332	.9582	1.0762	1.2012	1.3262	1.4512
	Class 3..	Max....	.3503	.4076	.4701	.5294	.5919	.7126	.8322	.9572	1.0749	1.1999	1.3249	1.4499
		Min....	.3500	.4073	.4698	.5291	.5916	.7123	.8319	.9569	1.0746	1.1996	1.3246	1.4496
	Class 4..	Max....	.3491	.4063	.4688	.5279	.5904	.7110	.8304	.9554	1.0729	1.1979	1.3229	1.4479
		Min....	.3490	.4062	.4687	.52775	.59025	.7108	.8302	.9552	1.0727	1.1977	1.3227	1.4477
(OPTIONAL)														
Pitch diameter of thread plug gages for inspection (see par. 6, p. 31).	Class 1..	Max....	.3528	.4104	.4729	.5324	.5949	.7160	.8359	.9609	1.0791	1.2041	1.3291	1.4541
		Min....	.3525	.4101	.4726	.5321	.5946	.7157	.8356	.9606	1.0788	1.2038	1.3288	1.4538
	Class 2..	Max....	.3515	.4089	.4714	.5308	.5933	.7142	.8338	.9588	1.0768	1.2018	1.3268	1.4518
		Min....	.3512	.4086	.4711	.5305	.5930	.7139	.8335	.9585	1.0765	1.2015	1.3265	1.4515
	Class 3..	Max....	.3506	.4079	.4704	.5297	.5922	.7129	.8325	.9575	1.0752	1.2002	1.3252	1.4502
		Min....	.3503	.4076	.4701	.5294	.5919	.7126	.8322	.9572	1.0749	1.1999	1.3249	1.4499
	Class 4..	Max....	.3492	.4064	.4689	.52805	.59055	.7112	.8306	.9556	1.0731	1.1981	1.3231	1.4481
		Min....	.3491	.4063	.4688	.5279	.5904	.7110	.8304	.9554	1.0729	1.1979	1.3229	1.4479

TABLE 28.—*Limiting dimensions of Y plain gages for screws and nuts of classes 1, 2, 3, and 4 fits, American National fine thread series*

Size	Threads per inch	Gages for major diameter of screw								Gages for minor diameter of nut			
		"Go" gages				"Not go" gages				"Go" gage		"Not go" gage	
		Class 1		Classes, 2, 3, and 4		Class 1		Classes, 2, 3, and 4					
		Maximum	Minimum	Maximum	Minimum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
0	80	0.05930	0.05923	0.06000	0.05993	0.05450	0.05457	0.05660	0.05667	0.04650	0.04657	0.05140	0.05133
1	72	.07230	.07223	.07300	.07293	.06730	.06737	.06940	.06947	.05800	.05807	.06340	.06333
2	64	.08530	.08523	.08600	.08593	.08010	.08017	.08220	.08227	.06910	.06917	.07460	.07453
3	56	.09820	.09813	.09900	.09893	.09260	.09267	.09500	.09507	.07970	.07977	.08560	.08553
4	48	.11110	.11103	.11200	.11193	.10490	.10497	.10760	.10767	.08940	.08947	.09600	.09593
5	44	.12410	.12403	.12500	.12493	.11770	.11777	.12040	.12047	.10040	.10047	.10680	.10673
6	40	.13700	.13693	.13800	.13793	.13020	.13027	.13320	.13327	.11090	.11097	.11790	.11783
8	36	.16290	.16283	.16400	.16393	.15570	.15577	.15900	.15907	.13390	.13397	.14020	.14013
10	32	.18890	.18883	.19000	.18993	.18130	.18137	.18460	.18467	.15620	.15627	.16240	.16233
12	28	.21480	.21473	.21600	.21593	.20620	.20627	.20980	.20987	.17730	.17737	.18350	.18343
1/4	28	.24880	.24873	.25000	.24993	.24020	.24027	.24380	.24387	.21130	.21137	.21730	.21723
5/16	24	.31120	.31113	.31250	.31243	.30200	.30207	.30590	.30597	.26740	.26747	.27390	.27383
3/8	24	.37370	.37363	.37500	.37493	.36150	.36457	.36840	.36847	.32990	.32997	.33640	.33633
7/16	20	.43600	.43593	.43750	.43743	.42580	.42587	.43030	.43037	.38340	.38347	.39060	.39053
1/2	20	.49850	.49843	.50000	.49993	.48830	.48837	.49280	.49287	.44590	.44597	.45310	.45303
9/16	18	.56090	.56083	.56250	.56243	.54950	.54957	.55430	.55437	.50240	.50247	.51000	.50993
5/8	18	.62340	.62333	.62500	.62493	.61200	.61207	.61680	.61687	.56490	.56497	.57250	.57243
3/4	16	.74820	.74813	.75000	.74993	.73560	.73567	.74100	.74107	.68230	.68237	.69030	.69023
7/8	14	.87290	.87281	.87500	.87491	.85890	.85899	.86520	.86529	.79770	.79777	.80620	.80613
1	14	.99790	.99781	1.00000	.99991	.98390	.98399	.99020	.99029	.92270	.92279	.93120	.93111
1 1/8	12	1.12260	1.12251	1.12500	1.12491	1.10680	1.10689	1.11380	1.11389	1.03480	1.03489	1.04380	1.04371
1 1/4	12	1.24760	1.24751	1.25000	1.24991	1.23180	1.23189	1.23880	1.23889	1.15980	1.15989	1.16880	1.16871
1 3/8	12	1.37260	1.37251	1.37500	1.37491	1.35680	1.35689	1.36380	1.36389	1.28480	1.28489	1.29380	1.29371
1 1/2	12	1.49760	1.49751	1.50000	1.49991	1.48180	1.48189	1.48880	1.48889	1.40980	1.40989	1.41880	1.41871

TABLE 29.—*Limiting dimensions of setting plug and thread ring gages and plain gages for screws of class 5 fit for threaded studs, American National fine-thread series*

Limiting dimensions		Size (inches)													
		¼	5/16	3/8	7/16	½	9/16	5/8	¾	7/8	1	1⅛	1¼	1⅜	1½
		Threads per inch													
		28	24	24	20	20	18	18	16	14	14	12	12	12	12
"GO" THREAD GAGES FOR SCREWS															
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Max....	*Inch* 0.2544	*Inch* 0.3172	*Inch* 0.3799	*Inch* 0.4427	*Inch* 0.5055	*Inch* 0.5686	*Inch* 0.6311	*Inch* 0.7565	*Inch* 0.8821	*Inches* 1.0075	*Inches* 1.1331	*Inches* 1.2578	*Inches* 1.3823	*Inches* 1.5068
	Min....	.2539	.3167	.3794	.4422	.5050	.5681	.6306	.7559	.8815	1.0069	1.1325	1.2572	1.3817	1.5062
Major diameter of truncated portion of truncated setting plug.	Max....	.2438	.3059	.3684	.4303	.4928	.5543	.6168	.7410	.8652	.9902	1.1138	1.2388	1.3638	1.4888
	Min....	.2433	.3054	.3679	.4298	.4923	.5538	.6163	.7404	.8646	.9896	1.1132	1.2382	1.3632	1.4882
Pitch diameter of setting plug or ring gage.	Max W..	.2307	.2896	.3523	.4097	.4725	.5320	.5945	.7153	.8351	.9605	1.0784	1.2031	1.3276	1.4521
	Min W..	.2306	.2895	.3522	.4096	.4724	.53185	.59435	.7151	.8349	.9603	1.0782	1.2029	1.3274	1.4519
Minor diameter of ring gage.....	Max....	.2152	.2716	.3343	.3881	.4509	.5080	.5705	.6882	.8042	.9296	1.0423	1.1670	1.2915	1.4160
	Min....	.2147	.2711	.3338	.3876	.4504	.5075	.5700	.6876	.8036	.9290	1.0417	1.1664	1.2909	1.4154
"NOT GO" THREAD GAGES FOR SCREWS															
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Min....	.2539	.3167	.3794	.4422	.5050	.5681	.6306	.7559	.8815	1.0069	1.1325	1.2572	1.3817	1.5062
	Max....	.2544	.3172	.3799	.4427	.5055	.5686	.6311	.7565	.8821	1.0075	1.1331	1.2578	1.3823	1.5068
Major diameter of truncated portion of truncated setting plug.	Min....	.2446	.3059	.3686	.4295	.4923	.5541	.6166	.7402	.8636	.9890	1.1119	1.2366	1.3611	1.4856
	Max....	.2451	.3064	.3691	.4300	.4928	.5546	.6171	.7408	.8642	.9896	1.1125	1.2372	1.3617	1.4862
Pitch diameter of setting plug and ring gages for production and inspection.	Min W..	.2296	.2884	.3511	.4084	.4712	.5305	.5930	.7137	.8333	.9587	1.0764	1.2011	1.3256	1.4501
	Max W..	.2297	.2885	.3512	.4085	.4713	.53065	.59315	.7139	.8335	.9589	1.0766	1.2013	1.3258	1.4503
PLAIN GAGES FOR SCREWS															
"Go" gages for major diameter.....	Max....	.25000	.31250	.37500	.43750	.50000	.56250	.62500	.75000	.87500	1.00000	1.12500	1.25000	1.37500	1.50000
	Min....	.24993	.31243	.37493	.43743	.49993	.56243	.62493	.74993	.87491	.99991	1.12491	1.24991	1.37491	1.49991
"Not go" gages for major diameter.....	Min....	.24380	.30590	.36840	.43030	.49280	.55430	.61680	.74100	.86520	.99020	1.11380	1.23880	1.36380	1.48880
	Max....	.24387	.30597	.36847	.43037	.49287	.55437	.61687	.74107	.86529	.99029	1.11389	1.23889	1.36389	1.48889

TABLE 30.—*Limiting dimensions of thread plug gages and plain gages for nuts of class 5 fit for threaded studs, American National fine-thread series*

Limiting dimensions		Size (inches)													
		1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
		Threads per inch													
		28	24	24	20	20	18	18	16	14	14	12	12	12	12
"GO" THREAD GAGES FOR NUTS		*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage	Min.	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625	0.6250	0.7500	0.8750	1.0000	1.1250	1.2500	1.3750	1.5000
	Max.	.2505	.3130	.3755	.4380	.5005	.5630	.6255	.7506	.8756	1.0006	1.1256	1.2506	1.3756	1.5006
Pitch diameter of plug gage	Min W.	.2268	.2854	.3479	.4050	.4675	.5264	.5889	.7094	.8286	.9536	1.0709	1.1959	1.3209	1.4459
	Max W.	.2269	.2855	.3480	.4051	.4676	.52655	.58905	.7096	.8288	.9538	1.0711	1.1961	1.3211	1.4461
"NOT GO" THREAD GAGES FOR NUTS															
Major diameter of plug gage	Max.	.2445	.3058	.3683	.4293	.4918	.5535	.6160	.7397	.8631	.9881	1.1110	1.2357	1.3602	1.4847
	Min.	.2440	.3053	.3678	.4288	.4913	.5530	.6155	.7391	.8625	.9875	1.1104	1.2351	1.3596	1.4841
Pitch diameter of thread plug gages for production and inspection.	Max W.	.2290	.2878	.3503	.4076	.4701	.5294	.5919	.7126	.8322	.9572	1.0749	1.1996	1.3241	1.4486
	Min W.	.2289	.2877	.3502	.4075	.4700	.52925	.59175	.7124	.8320	.9570	1.0747	1.1994	1.3239	1.4484
PLAIN GAGES FOR NUTS															
"Go" gages for minor diameter	Min.	.21670	.27430	.33680	.39240	.45490	.51220	.57470	.69360	.81110	.93610	1.05070	1.17570	1.30070	1.42570
	Max.	.21677	.27437	.33687	.39247	.45497	.51227	.57477	.69367	.81117	.93619	1.05079	1.17579	1.30079	1.42579
"Not go" gages for minor diameter	Max.	.22060	.27880	.34130	.39780	.46030	.51820	.58070	.70040	.81880	.94380	1.05970	1.18470	1.30970	1.43470
	Min.	.22053	.27873	.34123	.39773	.46023	.51813	.58063	.70033	.81873	.94371	1.05961	1.18461	1.30961	1.43461

TABLE 31.—*Sizes of tap drills, American National fine-thread series*[1]

Size of thread	Threads per inch	Minor diameter of nut			Stock drills and corresponding percentage of basic thread depth[2]		
		Basic	Maximum	Minimum	Nominal size	Diameter	Percentage of depth of basic thread
		Inch	*Inch*	*Inch*		*Inch*	
0	80	0.0438	0.0514	0.0465	3/64 in.	0.0469	81
					1.25 mm	.0492	67
1	72	.0550	.0634	.0580	1.50 mm	.0591	77
					1.55 mm	.0610	67
2	64	.0657	.0746	.0691	#50	.0700	79
					#49	.0730	64
3	56	.0758	.0856	.0797	#46	.0810	78
					2.10 mm	.0827	70
					#44	.0860	56
4	48	.0849	.0960	.0894	2.30 mm	.0906	79
					3/32 in.	.0937	68
					#41	.0960	59
5	44	.0955	.1068	.1004	2.60 mm	.1024	77
					#37	.1040	71
					#36	.1065	63
6	40	.1055	.1179	.1109	#33	.1130	77
					#32	.1160	68
8	36	.1279	.1402	.1339	3.40 mm	.1339	83
					#29	.1360	78
					3.50 mm	.1378	73
					9/64 in.	.1406	65
10	32	.1494	.1624	.1562	5/32 in.	.1562	83
					#21[3]	.1590	76
					#20	.1610	71
					#19	.1660	59
12	28	.1696	.1835	.1773	#15	.1800	78
					4.70 mm #13	.1850	67
					3/16 in.	.1875	61
1/4	28	.2036	.2173	.2113	#3	.2130	80
5/16	24	.2584	.2739	.2674	17/64 in.	.2656	87
					1	.2720	75
3/8	24	.3209	.3364	.3299	Q	.3320	79
7/16	20	.3725	.3906	.3834	W	.3860	79
					25/64 in.	.3906	72
1/2	20	.4350	.4531	.4459	[2] 9/64 in.	.4531	72
9/16	18	.4903	.5100	.5024	0.5062	.5062	78
5/8	18	.5528	.5725	.5649	14.5 mm	.5709	75
3/4	16	.6688	.6903	.6823	11/16 in.	.6875	77
					17.5 mm	.6890	75
7/8	14	.7822	.8062	.7977	51/64 in.	.7969	84
					20.5 mm	.8071	73
1	14	.9072	.9312	.9227	23.5 mm	.9252	81
1 1/8	12	1.0167	1.0438	1.0348	26.5 mm	1.0433	75
1 1/4	12	1.1417	1.1688	1.1598	29.5 mm	1.1614	82
1 3/8	12	1.2667	1.2938	1.2848	1 9/32 in.	1.2812	87
					1 19/64 in.	1.2969	72
1 1/2	12	1.3917	1.4188	1.4098	36 mm	1.4173	76

[1] Sizes of tap drills for class 5 fit are given in table 25.
[2] Drill sizes up to 1/2 inch are in agreement with ASA B5.12—1940, Twist Drills, Straight Shank, published by the ASME, 29 West 39th Street, New York, N. Y.
[3] This size is not included as standard in ASA B5.12—1940, but is listed in an appendix thereto.

4. AMERICAN NATIONAL EXTRA-FINE THREAD SERIES

The American National extra-fine thread series is intended for special uses where (*1*) thin-walled material is to be threaded, (*2*) thread depth of nuts clearing ferrules, coupling flanges, etc., must be held to a minimum, and (*3*) a maximum practicable number of threads are required within a given thread length. This thread series is the same as the SAE extra-fine thread series, but it includes additional sizes. The nominal sizes and basic dimensions are specified in table 14, p. 44.

Threads of the American National extra-fine thread series are designated by the symbol "NEF". Example:

Threaded part 1 inch diameter, 20 threads per inch, class 3 fit, mark..... *1"—20 NEF—3*

Limiting dimensions for the American National extra-fine thread series, classes 2 and 3, are given in table 32, the limiting dimensions of thread gages in tables 33, 34, and 35, and tap drill sizes in table 36.

TABLE 32.—*Limiting dimensions and tolerances, classes 2 and 3 fits, American National extra-fine thread series*

Dimensions and tolerances[1]	Size (inches)												
	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
	Threads per inch												
	32	32	32	28	28	24	24	24	20	20	20	20	20
BOLTS AND SCREWS	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
Classes 2 and 3, major diameter. Max...	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625	0.6250	0.6875	0.7500	0.8125	0.8750	0.9375	1.0000
Min...	.2446	.3071	.3696	.4313	.4938	.5559	.6184	.6809	.7428	.8053	.8678	.9303	.9928
Tol...	.0054	.0054	.0054	.0062	.0062	.0066	.0066	.0066	.0072	.0072	.0072	.0072	.0072
Classes 2 and 3, minor diameter..... Max[2]..	.2117	.2742	.3367	.3937	.4562	.5114	.5739	.6364	.6887	.7512	.8137	.8762	.9387
Class 2, pitch diameter.. Max[4]..	.2297	.2922	.3547	.4113	.4768	.5354	.5979	.6604	.7175	.7800	.8425	.9050	.9675
Min...	.2265	.2889	.3513	.4107	.4731	.5314	.5938	.6563	.7129	.7754	.8378	.9003	.9627
Tol...	.0032	.0033	.0034	.0036	.0037	.0040	.0041	.0041	.0046	.0046	.0047	.0047	.0048
Class 3, pitch diameter.. Max[4]..	.2297	.2922	.3547	.4143	.4768	.5354	.5979	.6604	.7175	.7800	.8425	.9050	.9675
Min...	.2275	.2899	.3523	.4118	.4742	.5326	.5950	.6575	.7143	.7768	.8392	.9017	.9641
Tol...	.0022	.0023	.0024	.0025	.0026	.0028	.0029	.0029	.0032	.0032	.0033	.0033	.0034
NUTS AND TAPPED HOLES													
Classes 2 and 3, major diameter..... Min[3]..	.2500	.3125	.3750	.4375	.5000	.5625	.6250	.6875	.7500	.8125	.8750	.9375	1.0000
Classes 2 and 3, minor diameter. Min...	.2162	.2787	.3412	.3988	.4613	.5174	.5799	.6424	.6959	.7584	.8209	.8834	.9459
Max...	.2208	.2833	.3458	.4041	.4666	.5235	.5860	.6485	.7027	.7652	.8277	.8902	.9527
Tol...	.0046	.0046	.0046	.0053	.0053	.0061	.0061	.0061	.0068	.0068	.0068	.0068	.0068
Class 2, pitch diameter.. Min[4]..	.2297	.2922	.3547	.4143	.4768	.5354	.5979	.6604	.7175	.7800	.8425	.9050	.9675
Max...	.2329	.2955	.3581	.4179	.4805	.5394	.6020	.6645	.7221	.7846	.8472	.9097	.9723
Tol...	.0032	.0033	.0034	.0036	.0037	.0040	.0041	.0041	.0046	.0046	.0047	.0047	.0048
Class 3, pitch diameter.. Min[4]..	.2297	.2922	.3547	.4143	.4768	.5354	.5979	.6604	.7175	.7800	.8425	.9050	.9675
Max...	.2319	.2945	.3571	.4168	.4794	.5382	.6008	.6633	.7207	.7832	.8458	.9083	.9709
Tol...	.0022	.0023	.0024	.0025	.0026	.0028	.0029	.0029	.0032	.0032	.0033	.0033	.0034

Dimensions and tolerances[1]	Size (inches)												
	1 1/16	1 1/8	1 3/16	1 1/4	1 5/16	1 3/8	1 7/16	1 1/2	1 9/16	1 5/8	1 11/16	1 3/4	2
	Threads per inch												
	18	18	18	18	18	18	18	18	18	18	18	16	16
BOLTS AND SCREWS	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Classes 2 and 3, major diameter. Max...	1.0625	1.1250	1.1875	1.2500	1.3125	1.3750	1.4375	1.5000	1.5625	1.6250	1.6875	1.7500	2.0000
Min...	1.0543	1.1168	1.1793	1.2418	1.3043	1.3668	1.4293	1.4918	1.5543	1.6168	1.6793	1.7410	1.9910
Tol...	.0082	.0082	.0082	.0082	.0082	.0082	.0082	.0082	.0082	.0082	.0082	.0090	.0090
Classes 2 and 3, minor diameter..... Max[2]..	.9943	1.0568	1.1193	1.1818	1.2443	1.3068	1.3693	1.4318	1.4943	1.5568	1.6193	1.6733	1.9233
Class 2, pitch diameter.. Max[4]..	1.0264	1.0889	1.1514	1.2139	1.2764	1.3389	1.4014	1.4639	1.5264	1.5889	1.6514	1.7094	1.9594
Min...	1.0216	1.0837	1.1462	1.2086	1.2711	1.3335	1.3960	1.4584	1.5209	1.5833	1.6458	1.7035	1.9533
Tol...	.0048	.0052	.0052	.0053	.0053	.0054	.0054	.0055	.0055	.0056	.0056	.0059	.0061
Class 3, pitch diameter.. Max[4]..	1.0264	1.0889	1.1514	1.2139	1.2764	1.3389	1.4014	1.4639	1.5264	1.5889	1.6514	1.7094	1.9594
Min...	1.0228	1.0853	1.1478	1.2102	1.2727	1.3351	1.3976	1.4601	1.5225	1.5850	1.6475	1.7053	1.9551
Tol...	.0036	.0036	.0036	.0037	.0037	.0038	.0038	.0038	.0039	.0039	.0039	.0041	.0043
NUTS AND TAPPED HOLES													
Classes 2 and 3, major diameter..... Min[3]..	1.0625	1.1250	1.1875	1.2500	1.3125	1.3750	1.4375	1.5000	1.5625	1.6250	1.6875	1.7500	2.0000
Classes 2 and 3, minor diameter. Min...	1.0024	1.0649	1.1274	1.1899	1.2524	1.3149	1.3774	1.4399	1.5024	1.5649	1.6274	1.6823	1.9323
Max...	1.0099	1.0724	1.1349	1.1974	1.2599	1.3224	1.3849	1.4474	1.5099	1.5724	1.6349	1.6903	1.9403
Tol...	.0075	.0075	.0075	.0075	.0075	.0075	.0075	.0075	.0075	.0075	.0075	.0080	.0080
Class 2, pitch diameter.. Min[4]..	1.0264	1.0889	1.1514	1.2139	1.2764	1.3389	1.4014	1.4639	1.5264	1.5889	1.6514	1.7094	1.9594
Max...	1.0312	1.0941	1.1566	1.2192	1.2817	1.3443	1.4068	1.4694	1.5319	1.5945	1.6570	1.7153	1.9655
Tol...	.0048	.0052	.0052	.0053	.0053	.0054	.0054	.0055	.0055	.0056	.0056	.0059	.0061
Class 3, pitch diameter.. Min[4]..	1.0264	1.0889	1.1514	1.2139	1.2764	1.3389	1.4014	1.4639	1.5264	1.5889	1.6514	1.7094	1.9594
Max...	1.0300	1.0925	1.1550	1.2176	1.2801	1.3427	1.4052	1.4677	1.5303	1.5928	1.6553	1.7135	1.9637
Tol...	.0036	.0036	.0036	.0037	.0037	.0038	.0038	.0038	.0039	.0039	.0039	.0041	.0043

[1] Pitch diameter tolerances include errors of lead and angle. The class 2 tolerances are based on the formulas in table 143 and a length of engagement of 6 threads. The class 3 tolerances are 70 percent of the class 2 tolerances.

[2] Dimensions given for the maximum minor diameter of the screw are figured to the intersection of the worn tool arc with a center line through crest and root. The minimum minor diameter of the screw shall be that corresponding to a flat at the minor diameter of the minimum screw equal to $\frac{1}{8} \times p$, and may be determined by subtracting the basic thread depth, h (or $0.6495\ p$), from the minimum pitch diameter of the screw.

[3] Dimensions for the minimum major diameter of the nut correspond to the basic flat ($\frac{1}{8} \times p$), and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the nut shall be that corresponding to a flat at the major diameter of the maximum nut equal to $\frac{1}{24} \times p$, and may be determined by adding $1\frac{2}{9} \times h$ (or $0.7939\ p$) to the maximum pitch diameter of the nut.

[4] These dimensions are the maximum metal or "go" size, and are those which should be placed on the component drawing with the tolerances.

TABLE 33.—*Limiting dimensions of setting plug and thread ring gages for screws of classes 2 and 3 fits, American National extra-fine thread series*

Limiting dimensions			Size (inches)											
			¼	5/16	⅜	7/16	½	9/16	⅝	11/16	¾	13/16	⅞	15/16	1
			Threads per inch												
			32	32	32	28	28	24	24	24	20	20	20	20	20
"GO" GAGES FOR SCREWS															
Major diameter of full-form setting plug, and of full portion of truncated setting plug.	Classes 2 and 3.	Max....	Inch 0.2505	Inch 0.3130	Inch 0.3755	Inch 0.4380	Inch 0.5005	Inch 0.5630	Inch 0.6255	Inch 0.6880	Inch 0.7505	Inch 0.8130	Inch 0.8755	Inch 0.9380	Inch 1.0005
		Min....	.2500	.3125	.3750	.4375	.5000	.5625	.6250	.6875	.7500	.8125	.8750	.9375	1.0000
Major diameter of truncated portion of truncated setting plug.	Classes 2 and 3.	Max....	.2446	.3071	.3696	.4313	.4938	.5559	.6184	.6809	.7428	.8053	.8678	.9303	.9928
		Min....	.2441	.3066	.3691	.4308	.4933	.5554	.6179	.6804	.7423	.8048	.8673	.9298	.9923
Pitch diameter of setting plug or ring gage.	Classes 2 and 3.	Max Y..	.2296	.2921	.3546	.4141	.4766	.5352	.5977	.6602	.7173	.7798	.8423	.9048	.9673
		Min Y..	.2293	.2918	.3543	.4138	.4763	.5349	.5974	.6599	.7170	.7795	.8420	.9045	.9670
		Max X..	.2297	.2922	.3547	.4143	.4768	.5354	.5979	.6604	.7175	.7800	.8425	.9050	.9675
		Min X..	.2294	.2919	.3544	.4140	.4765	.5351	.5976	.6601	.7172	.7797	.8422	.9047	.9672
Minor diameter of ring gage.....	Classes 2 and 3.	Max....	.2162	.2787	.3412	.3988	.4613	.5174	.5799	.6424	.6959	.7584	.8209	.8834	.9459
		Min....	.2157	.2782	.3407	.3983	.4608	.5169	.5794	.6419	.6954	.7579	.8204	.8829	.9454
"NOT GO" GAGES FOR SCREWS															
Major diameter of full-form setting plug, and of full portion of truncated setting plug.	Classes 2 and 3.	Min....	.2500	.3125	.3750	.4375	.5000	.5625	.6250	.6875	.7500	.8125	.8750	.9375	1.0000
		Max....	.2505	.3130	.3755	.4380	.5005	.5630	.6255	.6880	.7505	.8130	.8755	.9380	1.0005
Major diameter of truncated portion of truncated setting plug.	Class 2..	Min....	.2395	.3019	.3643	.4257	.4881	.5489	.6113	.6738	.7341	.7966	.8590	.9215	0.9839
		Max....	.2400	.3024	.3648	.4262	.4886	.5494	.6118	.6743	.7346	.7971	.8595	.9220	.9844
	Class 3..	Min....	.2405	.3029	.2653	.4268	.1892	.5501	.6125	.6750	.7355	.7980	.8604	.9229	.9853
		Max....	.2410	.3034	.3658	.4273	.4897	.5506	.6130	.6755	.7360	.7985	.8609	.9234	.9858
Pitch diameter of setting plug or ring gages for production and inspection.	Class 2..	Min....	.2265	.2889	.3513	.4107	.4731	.5314	.5938	.6563	.7129	.7754	.8378	.9003	.9627
		Max....	.2268	.2892	.3516	.4110	.4734	.5317	.5941	.6566	.7132	.7757	.8381	.9006	.9630
	Class 3..	Min....	.2275	.2899	.3523	.4118	.4742	.5326	.5950	.6575	.7143	.7768	.8392	.9017	.9641
		Max....	.2278	.2902	.3526	.4121	.4745	.5329	.5953	.6578	.7146	.7771	.8395	.9020	.9644
(OPTIONAL)															
Pitch diameter of setting plug or ring gages for inspection. (See par. 6, p. 31.)	Class 2..	Min....	.2262	.2886	.3510	.4104	.4728	.5311	.5935	.6560	.7126	.7751	.8375	.9000	.9624
		Max....	.2265	.2889	.3513	.4107	.4731	.5314	.5938	.6563	.7129	.7754	.8378	.9003	.9627
	Class 3..	Min....	.2272	.2896	.3520	.4115	.4739	.5323	.5947	.6572	.7140	.7765	.8389	.9014	.9638
		Max....	.2275	.2899	.3523	.4118	.4742	.5326	.5950	.6575	.7143	.7768	.8392	.9017	.9641
Minor diameter of ring gage.....	Class 2..	Min....	.2197	.2821	.3445	.4030	.4654	.5224	.5848	.6473	.7021	.7646	.8270	.8895	.9519
		Max....	.2202	.2826	.3450	.4035	.4659	.5229	.5853	.6478	.7026	.7651	.8275	.8900	.9524
	Class 3..	Min....	.2207	.2831	.3455	.4041	.4665	.5236	.5860	.6485	.7035	.7660	.8284	.8909	.9533
		Max....	.2212	.2836	.3460	.4046	.4670	.5241	.5865	.6490	.7040	.7665	.8289	.8914	.9538

Limiting dimensions	Size (inches)												
	1 1/16	1 1/8	1 3/16	1 1/4	1 5/16	1 3/8	1 7/16	1 1/2	1 9/16	1 5/8	1 11/16	1 3/4	2
	Threads per inch												
	18	18	18	18	18	18	18	18	18	18	18	16	16
"GO" GAGES FOR SCREWS													
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of full-form setting plug, and of full portion of truncated setting plug. — Classes 2 and 3. — Max.	1.0630	1.1255	1.1880	1.2505	1.3130	1.3755	1.4380	1.5005	1.5630	1.6255	1.6880	1.7506	2.0006
Major diameter of full-form setting plug, and of full portion of truncated setting plug. — Classes 2 and 3. — Min.	1.0625	1.1250	1.1875	1.2500	1.3125	1.3750	1.4375	1.5000	1.5625	1.6250	1.6875	1.7500	2.0000
Major diameter of truncated portion of truncated setting plug. — Classes 2 and 3. — Max.	1.0543	1.1168	1.1793	1.2418	1.3043	1.3668	1.4293	1.4918	1.5543	1.6168	1.6793	1.7410	1.9910
Major diameter of truncated portion of truncated setting plug. — Classes 2 and 3. — Min.	1.0538	1.1163	1.1788	1.2413	1.3038	1.3663	1.4288	1.4913	1.5538	1.6163	1.6788	1.7404	1.9904
Pitch diameter of setting plug or ring gage. — Classes 2 and 3. — Max Y.	1.0262	1.0887	1.1512	1.2137	1.2762	1.3387	1.4012	1.4637	1.5262	1.5887	1.6512	1.7092	1.9592
Pitch diameter of setting plug or ring gage. — Classes 2 and 3. — Min Y.	1.0259	1.0884	1.1509	1.2134	1.2759	1.3384	1.4009	1.4634	1.5257	1.5882	1.6507	1.7086	1.9586
Pitch diameter of setting plug or ring gage. — Classes 2 and 3. — Max X.	1.0264	1.0889	1.1514	1.2139	1.2764	1.3389	1.4014	1.4639	1.5264	1.5889	1.6514	1.7094	1.9594
Pitch diameter of setting plug or ring gage. — Classes 2 and 3. — Min X.	1.0261	1.0886	1.1511	1.2136	1.2761	1.3386	1.4011	1.4636	1.5260	1.5885	1.6510	1.7090	1.9590
Minor diameter of ring gage. — Classes 2 and 3. — Max.	1.0024	1.0649	1.1274	1.1899	1.2524	1.3149	1.3774	1.4399	1.5024	1.5649	1.6274	1.6823	1.9323
Minor diameter of ring gage. — Classes 2 and 3. — Min.	1.0019	1.0644	1.1269	1.1894	1.2519	1.3144	1.3769	1.4394	1.5019	1.5644	1.6269	1.6817	1.9317
"NOT GO" GAGES FOR SCREWS													
Major diameter of full-form setting plug, and of full portion of truncated setting plug. — Classes 2 and 3. — Min.	1.0625	1.1250	1.1875	1.2500	1.3125	1.3750	1.4375	1.5000	1.5625	1.6250	1.6875	1.7500	2.0000
Major diameter of full-form setting plug, and of full portion of truncated setting plug. — Classes 2 and 3. — Max.	1.0630	1.1255	1.1880	1.2505	1.3130	1.3755	1.4380	1.5005	1.5630	1.6255	1.6880	1.7506	2.0006
Major diameter of truncated portion of truncated setting plug. — Class 2.. — Min.	1.0452	1.1073	1.1698	1.2322	1.2947	1.3571	1.4196	1.4820	1.5445	1.6069	1.6694	1.7300	1.9798
Major diameter of truncated portion of truncated setting plug. — Class 2.. — Max.	1.0457	1.1078	1.1703	1.2327	1.2952	1.3576	1.4201	1.4825	1.5450	1.6074	1.6699	1.7306	1.9804
Major diameter of truncated portion of truncated setting plug. — Class 3.. — Min.	1.0464	1.1089	1.1714	1.2338	1.2963	1.3587	1.4212	1.4837	1.5461	1.6086	1.6711	1.7318	1.9816
Major diameter of truncated portion of truncated setting plug. — Class 3.. — Max.	1.0469	1.1094	1.1719	1.2343	1.2968	1.3592	1.4217	1.4842	1.5466	1.6091	1.6716	1.7324	1.9822
Pitch diameter of setting plug or ring gages for production and inspection. — Class 2.. — Min.	1.0216	1.0837	1.1462	1.2086	1.2711	1.3335	1.3960	1.4584	1.5209	1.5833	1.6458	1.7035	1.9533
Pitch diameter of setting plug or ring gages for production and inspection. — Class 2.. — Max.	1.0219	1.0840	1.1465	1.2089	1.2714	1.3338	1.3963	1.4587	1.5213	1.5837	1.6462	1.7039	1.9537
Pitch diameter of setting plug or ring gages for production and inspection. — Class 3.. — Min.	1.0228	1.0853	1.1478	1.2102	1.2727	1.3351	1.3976	1.4601	1.5225	1.5850	1.6475	1.7053	1.9551
Pitch diameter of setting plug or ring gages for production and inspection. — Class 3.. — Max.	1.0231	1.0856	1.1481	1.2105	2.2730	1.3354	1.3979	1.4604	1.5229	1.5854	1.6479	1.7057	1.9555
(OPTIONAL)													
Pitch diameter of setting plug or ring gages for inspection. (See par. 6, p. 31.) — Class 2.. — Min.	1.0213	1.0834	1.1459	1.2083	1.2708	1.3332	1.3957	1.4581	1.5205	1.5829	1.6454	1.7031	1.9529
Pitch diameter of setting plug or ring gages for inspection. (See par. 6, p. 31.) — Class 2.. — Max.	1.0216	1.0837	1.1462	1.2086	1.2711	1.3335	1.3960	1.4584	1.5209	1.5833	1.6458	1.7035	1.9533
Pitch diameter of setting plug or ring gages for inspection. (See par. 6, p. 31.) — Class 3.. — Min.	1.0225	1.0850	1.1475	1.2099	1.2724	1.3348	1.3973	1.4598	1.5221	1.5846	1.6471	1.7049	1.9547
Pitch diameter of setting plug or ring gages for inspection. (See par. 6, p. 31.) — Class 3.. — Max.	1.0228	1.0853	1.1478	1.2102	1.2727	1.3351	1.3976	1.4601	1.5225	1.5850	1.6475	1.7053	1.9551
Minor diameter of ring gage. — Class 2.. — Min.	1.0096	1.0717	1.1342	1.1966	1.2591	1.3215	1.3840	1.4464	1.5089	1.5713	1.6338	1.6900	1.9398
Minor diameter of ring gage. — Class 2.. — Max.	1.0101	1.0722	1.1347	1.1971	1.2596	1.3220	1.3845	1.4469	1.5094	1.5718	1.6343	1.6906	1.9404
Minor diameter of ring gage. — Class 3.. — Min.	1.0108	1.0733	1.1358	1.1982	1.2607	1.3231	1.3856	1.4481	1.5105	1.5730	1.6355	1.6918	1.9416
Minor diameter of ring gage. — Class 3.. — Max.	1.0113	1.0738	1.1363	1.1987	1.2612	1.3236	1.3861	1.4486	1.5110	1.5735	1.6360	1.6924	1.9422

TABLE 34.—*Limiting dimensions of thread plug gages for nuts of classes 2 and 3 fits, American National extra-fine thread series*

Limiting dimensions			Size (inch)												
			1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
			Threads per inch												
			32	32	32	28	28	24	24	24	20	20	20	20	20
"GO" GAGES FOR NUTS			*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*
Major diameter of plug gage	Classes 2 and 3.	Min.	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625	0.6250	0.6875	0.7500	0.8125	0.8750	0.9375	1.0000
		Max.	.2505	.3130	.3755	.4380	.5005	.5630	.6255	.6880	.7505	.8130	.8755	.9380	1.0005
Pitch diameter of plug gage	Classes 2 and 3.	Min Y.	.2298	.2923	.3548	.4145	.4770	.5356	.5981	.6606	.7177	.7802	.8427	.9052	.9677
		Max Y.	.2301	.2926	.3551	.4148	.4773	.5359	.5984	.6609	.7180	.7805	.8430	.9055	.9680
		Min X.	.2297	.2922	.3547	.4143	.4768	.5354	.5979	.6604	.7175	.7800	.8425	.9050	.9675
		Max X.	.2300	.2925	.3550	.4146	.4771	.5357	.5982	.6607	.7178	.7803	.8428	.9053	.9678
"NOT GO" GAGES FOR NUTS															
Major diameter of plug gage	Class 2.	Max.	.2464	.3090	.3716	.4334	.4960	.5574	.6200	.6825	.7438	.8063	.8689	.9314	.9940
		Min.	.2459	.3085	.3711	.4329	.4955	.5569	.6195	.6820	.7433	.8058	.8684	.9309	.9935
	Class 3.	Max.	.2454	.3080	.3706	.4323	.4949	.5562	.6188	.6813	.7424	.8049	.8675	.9300	.9926
		Min.	.2449	.3075	.3701	.4318	.4944	.5557	.6183	.6808	.7419	.8044	.8670	.9295	.9921
Pitch diameter of thread plug gages for production and inspection.	Class 2.	Max.	.2329	.2955	.3581	.4179	.4805	.5394	.6020	.6645	.7221	.7846	.8472	.9097	.9723
		Min.	.2326	.2952	.3578	.4176	.4802	.5391	.6017	.6642	.7218	.7843	.8469	.9094	.9720
	Class 3.	Max.	.2319	.2945	.3571	.4168	.4791	.5382	.6008	.6633	.7207	.7832	.8458	.9083	.9709
		Min.	.2316	.2942	.3568	.4165	.4791	.5379	.6005	.6630	.7204	.7829	.8455	.9080	.9706
(OPTIONAL)															
Pitch diameter of thread plug gages for inspection (see par. 6, p. 31).	Class 2.	Max.	.2332	.2958	.3584	.4182	.4808	.5397	.6023	.6648	.7224	.7849	.8475	.9100	.9726
		Min.	.2329	.2955	.3581	.4179	.4805	.5394	.6020	.6645	.7221	.7846	.8472	.9097	.9723
	Class 3.	Max.	.2322	.2948	.3574	.4171	.4797	.5385	.6011	.6636	.7210	.7835	.8461	.9086	.9712
		Min.	.2319	.2945	.3571	.4168	.4794	.5382	.6008	.6633	.7207	.7832	.8458	.9083	.9709

TABLE 34.—*Limiting dimensions of thread plug gages for nuts of classes 2 and 3 fits, American National extra-fine thread series*—Continued

Limiting dimensions			Size (inches)											
			1 1/16	1 1/8	1 3/16	1 1/4	1 5/16	1 3/8	1 7/16	1 1/2	1 9/16	1 5/8	1 11/16	1 3/4	2
			Threads per inch												
			18	18	18	18	18	18	18	18	18	18	18	16	16
"Go" Gages for Nuts			*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage.....	Classes 2 and 3.	Min....	1.0625	1.1250	1.1875	1.2500	1.3125	1.3750	1.4375	1.5000	1.5625	1.6250	1.6875	1.7500	2.0000
		Max....	1.0630	1.1255	1.1880	1.2505	1.3130	1.3755	1.4380	1.5005	1.5630	1.6255	1.6880	1.7506	2.0006
Pitch diameter of plug gage.....	Classes 2 and 3.	Min Y..	1.0266	1.0891	1.1516	1.2141	1.2766	1.3391	1.4016	1.4641	1.5266	1.5891	1.6516	1.7096	1.9596
		Max Y..	1.0269	1.0894	1.1519	1.2144	1.2769	1.3394	1.4019	1.4644	1.5271	1.5896	1.6521	1.7102	1.9602
		Min X..	1.0264	1.0889	1.1514	1.2139	1.2764	1.3389	1.4014	1.4639	1.5264	1.5889	1.6514	1.7094	1.9594
		Max X..	1.0267	1.0892	1.1517	1.2142	1.2767	1.3392	1.4017	1.4642	1.5268	1.5893	1.6518	1.7098	1.9598
"Not Go" Gages for Nuts															
Major diameter of plug gage.....	Class 2..	Max....	1.0553	1.1182	1.1807	1.2433	1.3058	1.3684	1.4309	1.4935	1.5560	1.6186	1.6811	1.7424	1.9926
		Min....	1.0548	1.1177	1.1802	1.2428	1.3053	1.3679	1.4304	1.4930	1.5555	1.6181	1.6806	1.7418	1.9920
	Class 3..	Max....	1.0541	1.1166	1.1791	1.2417	1.3042	1.3668	1.4293	1.4918	1.5544	1.6169	1.6794	1.7406	1.9908
		Min....	1.0536	1.1161	1.1786	1.2412	1.3037	1.3663	1.4288	1.4913	1.5539	1.6164	1.6789	1.7400	1.9902
Pitch diameter of thread plug gages for production and inspection.	Class 2..	Max....	1.0312	1.0941	1.1566	1.2192	1.2817	1.3443	1.4068	1.4694	1.5319	1.5945	1.6570	1.7153	1.9655
		Min....	1.0309	1.0938	1.1563	1.2189	1.2814	1.3440	1.4065	1.4691	1.5315	1.5941	1.6566	1.7149	1.9651
	Class 3..	Max....	1.0300	1.0925	1.1550	1.2176	1.2801	1.3427	1.4052	1.4677	1.5303	1.5928	1.6553	1.7135	1.9637
		Min....	1.0297	1.0922	1.1547	1.2173	1.2798	1.3424	1.4049	1.4674	1.5299	1.5924	1.6549	1.7131	1.9633
(OPTIONAL)															
Pitch diameter of thread plug gages for inspection (see par. 6, p. 31).	Class 2..	Max....	1.0315	1.0944	1.1569	1.2195	1.2820	1.3446	1.4071	1.4697	1.5323	1.5949	1.6574	1.7157	1.9659
		Min....	1.0312	1.0941	1.1566	1.2192	1.2817	1.3443	1.4068	1.4694	1.5319	1.5945	1.6570	1.7153	1.9655
	Class 3..	Max....	1.0303	1.0928	1.1553	1.2179	1.2804	1.3430	1.4055	1.4680	1.5307	1.5932	1.6557	1.7139	1.9641
		Min....	1.0300	1.0925	1.1550	1.2176	1.2801	1.3427	1.4052	1.4677	1.5303	1.5928	1.6553	1.7135	1.9637

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TABLE 35.—*Limiting dimensions of Y plain gages for screws and nuts of classes 2 and 3 fits, American National extra-fine thread series*

Size	Threads per inch	Gages for major diameter of screw				Gages for minor diameter of nut			
		"Go" gage		"Not go" gage		"Go" gage		"Not go" gage	
		Maximum	Minimum	Minimum	Maximum	Minimum	Maximum	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1/4	32	0.25000	0.24993	0.24460	0.24467	0.21620	0.21627	0.22080	0.22073
5/16	32	.31250	.31243	.30710	.30717	.27870	.27877	.28330	.28323
3/8	32	.37500	.37493	.36960	.36967	.34120	.34127	.34580	.34573
7/16	28	.43750	.43743	.43130	.43137	.39880	.39887	.40410	.40403
1/2	28	.50000	.49993	.49380	.49387	.46130	.46137	.46660	.46653
9/16	24	.56250	.56243	.55590	.55597	.51740	.51747	.52350	.52343
5/8	24	.62500	.62493	.61840	.61847	.57990	.57997	.58600	.58593
11/16	24	.68750	.68743	.68090	.68097	.64240	.64247	.64850	.64843
3/4	20	.75000	.74993	.74280	.74287	.69590	.69597	.70270	.70263
13/16	20	.81250	.81243	.80530	.80537	.75840	.75847	.76520	.76513
7/8	20	.87500	.87491	.86780	.86789	.82090	.82097	.82770	.82761
15/16	20	.93750	.93741	.93030	.93039	.88340	.88349	.89020	.89011
1	20	1.00000	.99991	.99280	.99289	.94590	.94599	.95270	.95261
1 1/16	18	1.06250	1.06241	1.05430	1.05439	1.00240	1.00249	1.00990	1.00981
1 1/8	18	1.12500	1.12491	1.11680	1.11689	1.06490	1.06499	1.07240	1.07231
1 3/16	18	1.18750	1.18741	1.17930	1.17939	1.12740	1.12749	1.13490	1.13481
1 1/4	18	1.25000	1.24991	1.24180	1.24189	1.18990	1.18999	1.19740	1.19731
1 5/16	18	1.31250	1.31241	1.30430	1.30439	1.25240	1.25249	1.25990	1.25981
1 3/8	18	1.37500	1.37491	1.36680	1.36689	1.31490	1.31499	1.32240	1.32231
1 7/16	18	1.43750	1.43741	1.42930	1.42939	1.37740	1.37749	1.38490	1.38481
1 1/2	18	1.50000	1.49991	1.49180	1.49189	1.43990	1.43999	1.44740	1.44731
1 9/16	18	1.56250	1.56238	1.55430	1.55442	1.50240	1.50249	1.50990	1.50981
1 5/8	18	1.62500	1.62488	1.61680	1.61692	1.56490	1.56502	1.57240	1.57228
1 11/16	18	1.68750	1.68738	1.67930	1.67942	1.62740	1.62752	1.63490	1.63478
1 3/4	16	1.75000	1.74988	1.74100	1.74112	1.68230	1.68242	1.69030	1.69018
2	16	2.00000	1.99988	1.99100	1.99112	1.93230	1.93242	1.94030	1.94018

TABLE 36.—*Sizes of tap drills, American National extra-fine thread series*

Size of thread	Threads per inch	Minor diameter of nut			Stock drills and corresponding percentage of basic thread depth[1]		
		Basic	Maximum	Minimum	Nominal size	Diameter	Percentage of depth of basic thread
		Inch	*Inch*	*Inch*		*Inch*	
¼	32	0.2094	0.2208	0.2162	*5.5 mm²*	*0.2165*	*83*
					7/32 in.	.2188	77
					5.6 mm²	*.2205*	*73*
5/16	32	.2719	.2833	.2787	*7.1 mm²*	*.2795*	*81*
					K[2]	.2810	77
					9/32 in.	.2812	77
3/8	32	.3344	.3458	.3412	*8.7 mm²*	*.3425*	*80*
					11/32 in.	*.3438*	*77*
					8.75 mm²	*.3445*	*75*
7/16	28	.3911	.4041	.3988	*X*	*.3970*	*87*
					Y[2]	.4040	72
½	28	.4536	.4666	.4613	*29/64 in.*	*.4531*	*101*
					15/32 in.	*.4687*	*67*
9/16	24	.5084	.5235	.5174	*33/64 in.*	*.5156*	*87*
					17/32 in.	*.5312*	*58*
5/8	24	.5709	.5860	.5799	*37/64 in.*	*.5781*	*87*
					15 mm	*.5906*	*64*
11/16	24	.6334	.6485	.6424	*41/64 in.*	*.6406*	*87*
					16.5 mm	*.6496*	*70*
¾	20	.6850	.7027	.6959	*17.5 mm*	*.6890*	*94*
					45/64 in.	*.7031*	*72*
13/16	20	.7475	.7652	.7584	*¾ in.*	*.7500*	*96*
					49/64 in.	*.7656*	*72*
7/8	20	.8100	.8277	.8209	*21 mm*	*.8268*	*74*
15/16	20	.8725	.8902	.8834	*22.5 mm*	*.8858*	*80*
1	20	.9350	.9527	.9459	*24 mm*	*.9449*	*85*
					61/64 in.	*.9531*	*72*
1 1/16	18	.9903	1.0099	1.0024	*25.5 mm*	1.0040	81
1 1/8	18	1.0528	1.0724	1.0649	*27 mm*	*1.0630*	*86*
					1 5/64 in.	*1.0781*	*65*
1 3/16	18	1.1153	1.1349	1.1274	*1 1/8 in.*	*1.1250*	*87*
					1 9/64 in.	*1.1406*	*65*
1 ¼	18	1.1778	1.1974	1.1899	*1 3/16 in.*	*1.1875*	*87*
					30.5 mm	*1.2008*	*68*
1 5/16	18	1.2403	1.2599	1.2524	*32 mm*	1.2598	73
1 3/8	18	1.3028	1.3224	1.3149	*33.5 mm*	1.3189	78
1 7/16	18	1.3653	1.3849	1.3774	*35 mm*	1.3780	82
1 ½	18	1.4278	1.4474	1.4399	*1 7/16 in.*	*1.4375*	*87*
					1 29/64 in.	*1.4531*	*65*
1 9/16	18	1.4903	1.5099	1.5024	*1 1/2 in.*	*1.5000*	*87*
					1 33/64 in.	*1.5156*	*65*
1 5/8	18	1.5528	1.5724	1.5649	*1 9/16 in.*	*1.5625*	*87*
					40 mm	*1.5748*	*70*
1 11/16	18	1.6153	1.6349	1.6274	*41.5 mm*	1.6339	74
1 ¾	16	1.6688	1.6903	1.6823	1 11/16 in.	1.6875	77
2	16	1.9188	1.9403	1.9323	1 15/16 in.	1.9375	77

[1]Sizes in italics are not within the specified limits for minor diameter of nut. See p. 43
[2]These sizes are not included as standard in American Standard B 5.12-1940 for Twist Drills, Straight Shank, but are listed in the appendix thereto.

5. AMERICAN NATIONAL 8-PITCH THREAD SERIES

The nominal sizes and basic dimensions of the "American National 8-pitch thread series," are specified in table 15, p. 45.

Bolts for high-pressure pipe flanges, cylinder-head studs, and similar fastenings against pressure require that an initial tension be set up in the fastening, by elastic deformation of the fastening and the components held together, such that the joint will not open up when the steam or other pressure is applied. To secure a proper initial tension it is not practicable that the pitch should increase with the diameter of the thread, as the torque required to assemble the fastening would be excessive. Accordingly, for such purposes the 8-pitch thread has come into general use.

Threads of the American National 8-pitch thread series are designated by the symbol "8N." Example:

Threaded part 1½ inches diameter, 8 threads per inch, class 2 fit, mark.....1½"—8N—2

Limiting dimensions for the American National 8-pitch thread series, classes 2 and 3, are given in table 37, the limiting dimensions of thread gages in tables 38, 39, and 40, and tap drill sizes in table 41.

TABLE 37.—*Limiting dimensions and tolerances, classes 2 and 3 fits, American National 8-pitch thread series*

Dimensions and tolerances[1]	Size (inches)								
	1[2]	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2
BOLTS AND SCREWS									
	Inch	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Classes 2 and 3, major diameter.... Max...	1.0000	1.1250	1.2500	1.3750	1.5000	1.6250	1.7500	1.8750	2.0000
Min...	.9848	1.1098	1.2348	1.3598	1.4848	1.6098	1.7348	1.8598	1.9848
Tol...	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152
Classes 2 and 3, minor diameter.... Max[3]..	.8466	.9716	1.0966	1.2216	1.3466	1.4716	1.5966	1.7216	1.8466
Class 2, pitch diameter (for general use). Max[5]..	.9188	1.0438	1.1688	1.2938	1.4188	1.5438	1.6688	1.7938	1.9188
Min...	.9112	1.0359	1.1605	1.2852	1.4098	1.5345	1.6591	1.7838	1.9084
Tol...	.0076	.0079	.0083	.0086	.0090	.0093	.0097	.0100	.0104
Class 3, pitch diameter..... Max[5]..	.9188	1.0438	1.1688	1.2938	1.4188	1.5438	1.6688	1.7938	1.9188
Min...	.9134	1.0383	1.1630	1.2877	1.4125	1.5373	1.6620	1.7868	1.9115
Tol...	.0054	.0055	.0058	.0061	.0063	.0065	.0068	.0070	.0073
NUTS AND TAPPED HOLES									
Classes 2 and 3, major diameter.... Min[4]..	1.0000	1.1250	1.2500	1.3750	1.5000	1.6250	1.7500	1.8750	2.0000
Classes 2 and 3, minor diameter.... Min...	.8647	.9897	1.1147	1.2397	1.3647	1.4897	1.6147	1.7397	1.8647
Max...	.8795	1.0045	1.1295	1.2545	1.3795	1.5045	1.6295	1.7545	1.8795
Tol...	.0148	.0148	.0148	.0148	.0148	.0148	.0148	.0148	.0148
Classes 2 and 3, pitch diameter.... Min[5]..	.9188	1.0438	1.1688	1.2938	1.4188	1.5438	1.6688	1.7938	1.9188
Class 2, pitch diameter (for general use). Max...	.9264	1.0517	1.1771	1.3024	1.4278	1.5531	1.6785	1.8038	1.9292
Tol...	.0076	.0079	.0083	.0086	.0090	.0093	.0097	.0100	.0104
Class 3, pitch diameter..... Max...	.9242	1.0493	1.1746	1.2999	1.4251	1.5503	1.6756	1.8008	1.9261
Tol...	.0054	.0055	.0058	.0061	.0063	.0065	.0068	.0070	.0073

Dimensions and tolerances[1]	Size (inches)								
	2⅛	2¼	2½	2¾	3	3¼	3½	3¾	4
BOLTS AND SCREWS									
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Classes 2 and 3, major diameter.... Max...	2.1250	2.2500	2.5000	2.7500	3.0000	3.2500	3.5000	3.7500	4.0000
Min...	2.1098	2.2348	2.4848	2.7348	2.9848	3.2348	3.4848	3.7348	3.9848
Tol...	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152
Classes 2 and 3, minor diameter.... Max[3]..	1.9716	2.0966	2.3466	2.5966	2.8466	3.0966	3.3466	3.5966	3.8466
Class 2, pitch diameter (for general use). Max[5]..	2.0438	2.1688	2.4188	2.6688	2.9188	3.1688	3.4188	3.6688	3.9188
Min...	2.0331	2.1578	2.4071	2.6564	2.9058	3.1556	3.4055	3.6554	3.9053
Tol...	.0107	.0110	.0117	.0124	.0130	.0132	.0133	.0134	.0135
Class 3, pitch diameter..... Max[5]..	2.0438	2.1688	2.4188	2.6688	2.9188	3.1688	3.4188	3.6688	3.9188
Min...	2.0363	2.1611	2.4106	2.6601	2.9096	3.1595	3.4095	3.6594	3.9093
Tol...	.0075	.0077	.0082	.0087	.0092	.0093	.0093	.0094	.0095
NUTS AND TAPPED HOLES									
Classes 2 and 3, major diameter.... Min[4]..	2.1250	2.2500	2.5000	2.7500	3.0000	3.2500	3.5000	3.7500	4.0000
Classes 2 and 3, minor diameter.... Min...	1.9897	2.1147	2.3647	2.6147	2.8647	3.1147	3.3647	3.6147	3.8647
Max...	2.0045	2.1295	2.3795	2.6295	2.8795	3.1295	3.3795	3.6295	3.8795
Tol...	.0148	.0148	.0148	.0148	.0148	.0148	.0148	.0148	.0148
Classes 2 and 3, pitch diameter.... Min[5]..	2.0438	2.1688	2.4188	2.6688	2.9188	3.1688	3.4188	3.6688	3.9188
Class 2, pitch diameter (for general use). Max...	2.0545	2.1798	2.4305	2.6812	2.9318	3.1820	3.4321	3.6822	3.9323
Tol...	.0107	.0110	.0117	.0124	.0130	.0132	.0133	.0134	.0135
Class 3, pitch diameter..... Max...	2.0513	2.1765	2.4270	2.6775	2.9280	3.1781	3.4281	3.6782	3.9283
Tol...	.0075	.0077	.0082	.0087	.0092	.0093	.0093	.0094	.0095

See footnotes at end of table.

TABLE 37.—*Limiting dimensions and tolerances, classes 2 and 3 fits, American National 8-pitch thread series*—Continued

Dimensions and tolerances	Size (inches)							
	4¼	4½	4¾	5	5¼	5½	5¾	6
BOLTS AND SCREWS								
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Classes 2 and 3, major diameter..... Max...	4.2500	4.5000	4.7500	5.0000	5.2500	5.5000	5.7500	6.0000
Min...	4.2348	4.4848	4.7348	4.9848	5.2348	5.4848	5.7348	5.9848
Tol...	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152
Classes 2 and 3, minor diameter..... Max[3]..	4.0966	4.3466	4.5966	4.8466	5.0966	5.3466	5.5966	5.8466
Class 2, pitch diameter (for general use)... Max[5]..	4.1688	4.4188	4.6688	4.9188	5.1688	5.4188	5.6688	5.9188
Min...	4.1551	4.4050	4.6549	4.9048	5.1547	5.4046	5.6545	5.9044
Tol...	.0137	.0138	.0139	.0140	.0141	.0142	.0143	.0144
Class 3, pitch diameter..... Max[5]..	4.1688	4.4188	4.6688	4.9188	5.1688	5.4188	5.6688	5.9188
Min...	4.1592	4.4091	4.6590	4.9089	5.1589	5.4088	5.6587	5.9086
Tol...	.0096	.0097	.0098	.0099	.0099	.0100	.0101	.0102
NUTS AND TAPPED HOLES								
Classes 2 and 3, major diameter..... Min[4]..	4.2500	4.5000	4.7500	5.0000	5.2500	5.5000	5.7500	6.0000
Classes 2 and 3, minor diameter..... Min...	4.1147	4.3647	4.6147	4.8647	5.1147	5.3647	5.6147	5.8647
Max...	4.1295	4.3795	4.6295	4.8795	5.1295	5.3795	5.6295	5.8795
Tol...	.0148	.0148	.0148	.0148	.0148	.0148	.0148	.0148
Classes 2 and 3, pitch diameter..... Min[5]..	4.1688	4.4188	4.6688	4.9188	5.1688	5.4188	5.6688	5.9188
Class 2, pitch diameter (for general use)... Max...	4.1825	4.4326	4.6827	4.9328	5.1829	5.4330	5.6831	5.9332
Tol...	.0137	.0138	.0139	.0140	.0141	.0142	.0143	.0144
Class 3, pitch diameter..... Max...	4.1784	4.4285	4.6786	4.9287	5.1787	5.4288	5.6789	5.9290
Tol...	.0096	.0097	.0098	.0099	.0099	.0100	.0101	.0102

[1] Pitch diameter tolerances include errors of lead and angle. The class 2 tolerances are based on the formulas in table 143 and a length of engagement equal to the basic major diameter for sizes from 1⅛ to 3 inches, inclusive, and a length of engagement of 3 inches for sizes over the 3-inch. The class 3 tolerances are 70 percent of the class 2 tolerances. The 1-inch size being in the American National coarse-thread series, the tolerances for this size correspond to that series.

[2] Standard size screw and nut of the American National coarse-thread series.

[3] Dimensions given for the maximum minor diameter of the screw are figured to the intersection of the worn tool arc with a center line through crest and root. The minimum minor diameter of the screw shall be that corresponding to a flat at the minor diameter of the minimum screw equal to $\frac{1}{8} \times p$, and may be determined by subtracting 0.0812 inch from the minimum pitch diameter of the screw.

[4] Dimensions for the minimum major diameter of the nut correspond to the basic flat ($\frac{1}{8} \times p$), and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the nut shall be that corresponding to a flat at the major diameter of the maximum nut equal to $\frac{1}{24} \times p$, and may be determined by adding 0.0992 inch to the maximum pitch diameter of the nut.

[5] These dimensions are the maximum metal or "go" size, and are those which should be placed on the component drawing with the tolerances.

TABLE 38.—*Limiting dimensions of setting plug and thread ring gages for screws, classes 2 and 3 fits, American National 8-pitch thread series*

Limiting dimensions			Size (inches)											
			1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2½	2¾
"Go" Gages for Screws															
			Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Classes 2 and 3.	Max....	1.0007	1.1257	1.2507	1.3757	1.5007	1.6257	1.7507	1.8757	2.0007	2.1257	2.2507	2.5007	2.7507
		Min....	1.0000	1.1250	1.2500	1.3750	1.5000	1.6250	1.7500	1.8750	2.0000	2.1250	2.2500	2.5000	2.7500
Major diameter of truncated portion of truncated setting plug.	Classes 2 and 3.	Max....	0.9848	1.1098	1.2348	1.3598	1.4848	1.6098	1.7348	1.8598	1.9848	2.1098	2.2348	2.4848	2.7348
		Min....	.9841	1.1091	1.2341	1.3591	1.4841	1.6091	1.7341	1.8591	1.9841	2.1091	2.2341	2.4841	2.7341
Pitch diameter of setting plug or ring gage.....	Classes 2 and 3.	Max Y..	.9186	1.0436	1.1686	1.2936	1.4186	1.5436	1.6686	1.7936	1.9186	2.0436	2.1686	2.4186	2.6686
		Min Y..	.9181	1.0431	1.1681	1.2931	1.4181	1.5429	1.6679	1.7929	1.9179	2.0429	2.1679	2.4179	2.6679
		Max X..	.9188	1.0438	1.1688	1.2938	1.4188	1.5438	1.6688	1.7938	1.9188	2.0438	2.1688	2.4188	2.6688
		Min X..	.9184	1.0434	1.1684	1.2934	1.4184	1.5433	1.6683	1.7933	1.9183	2.0433	2.1683	2.4183	2.6683
Minor diameter of ring gage.....	Classes 2 and 3.	Max....	.8647	.9897	1.1147	1.2397	1.3647	1.4897	1.6147	1.7397	1.8647	1.9897	2.1147	2.3647	2.6147
		Min....	.8640	.9890	1.1140	1.2390	1.3640	1.4890	1.6140	1.7390	1.8640	1.9890	2.1140	2.3640	2.6140
"Not Go" Gages for Screws															
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Classes 2 and 3.	Min....	1.0000	1.1250	1.2500	1.3750	1.5000	1.6250	1.7500	1.8750	2.0000	2.1250	2.2500	2.5000	2.7500
		Max....	1.0007	1.1257	1.2507	1.3757	1.5007	1.6257	1.7507	1.8757	2.0007	2.1257	2.2507	2.5007	2.7507
Major diameter of truncated portion of truncated setting plug.	Class 2..	Min....	.9646	1.0893	1.2139	1.3386	1.4632	1.5879	1.7125	1.8372	1.9618	2.0865	2.2112	2.4605	2.7098
		Max....	.9653	1.0900	1.2146	1.3393	1.4639	1.5886	1.7132	1.8379	1.9625	2.0872	2.2119	2.4612	2.7105
	Class 3..	Min....	.9668	1.0917	1.2164	1.3411	1.4659	1.5907	1.7154	1.8402	1.9649	2.0897	2.2145	2.4640	2.7135
		Max....	.9675	1.0924	1.2171	1.3418	1.4666	1.5914	1.7161	1.8409	1.9656	2.0904	2.2152	2.4647	2.7142
Pitch diameter of setting plug and ring gages for production and inspection.	Class 2..	Min....	.9112	1.0359	1.1605	1.2852	1.4098	1.5345	1.6591	1.7838	1.9084	2.0331	2.1578	2.4071	2.6564
		Max....	.9116	1.0363	1.1609	1.2856	1.4102	1.5350	1.6596	1.7843	1.9089	2.0336	2.1583	2.4076	2.6569
	Class 3..	Min....	.9134	1.0383	1.1630	1.2877	1.4125	1.5373	1.6620	1.7868	1.9115	2.0363	2.1611	2.4106	2.6601
		Max....	.9138	1.0387	1.1634	1.2881	1.4129	1.5378	1.6625	1.7873	1.9120	2.0368	2.1616	2.4111	2.6606
(OPTIONAL)															
Pitch diameter of setting plug and ring gages for inspection. (See par. 6, p. 31.)	Class 2..	Min....	.9108	1.0355	1.1601	1.2848	1.4094	1.5340	1.6586	1.7833	1.9079	2.0326	2.1573	2.4066	2.6559
		Max....	.9112	1.0359	1.1605	1.2852	1.4098	1.5345	1.6591	1.7838	1.9084	2.0331	2.1578	2.4071	2.6564
	Class 3..	Min....	.9130	1.0379	1.1626	1.2873	1.4121	1.5368	1.6615	1.7863	1.9110	2.0358	2.1606	2.4101	2.6596
		Max....	.9134	1.0383	1.1630	1.2877	1.4125	1.5373	1.6620	1.7868	1.9115	2.0363	2.1611	2.4106	2.6601
Minor diameter of ring gage.....	Class 2..	Min....	.8841	1.0088	1.1334	1.2581	1.3827	1.5074	1.6320	1.7567	1.8813	2.0060	2.1307	2.3800	2.6293
		Max....	.8848	1.0095	1.1341	1.2588	1.3834	1.5081	1.6327	1.7574	1.8820	2.0067	2.1314	2.3807	2.6300
	Class 3..	Min....	.8863	1.0112	1.1359	1.2606	1.3854	1.5102	1.6349	1.7597	1.8844	2.0092	2.1340	2.3835	2.6330
		Max....	.8870	1.0119	1.1366	1.2613	1.3861	1.5109	1.6356	1.7604	1.8851	2.0099	2.1347	2.3842	2.6337

Limiting dimensions			Size (inches)											
			3	3¼	3½	3¾	4	4¼	4½	4¾	5	5¼	5½	5¾	6
"Go" Gages for Screws															
			Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Classes 2 and 3.	Max....	3.0007	3.2507	3.5007	3.7507	4.0007	4.2511	4.5011	4.7511	5.0011	5.2511	5.5011	5.7511	6.0011
		Min....	3.0000	3.2500	3.5000	3.7500	4.0000	4.2500	4.5000	4.7500	5.0000	5.2500	5.5000	5.7500	6.0000
Major diameter of truncated portion of truncated setting plug.	Classes 2 and 3.	Max....	2.9848	3.2348	3.4848	3.7348	3.9848	4.2348	4.4848	4.7348	4.9848	5.2348	5.4848	5.7348	5.9848
		Min....	2.9841	3.2341	3.4841	3.7341	3.9841	4.2337	4.4837	4.7337	4.9837	5.2337	5.4837	5.7337	5.9837
Pitch diameter of setting plug or ring gage.....	Classes 2 and 3.	Max Y..	2.9186	3.1686	3.4186	3.6686	3.9186	4.1686	4.4186	4.6686	4.9186	5.1686	5.4186	5.6686	5.9186
		Min Y..	2.9179	3.1679	3.4179	3.6679	3.9179	4.1677	4.4177	4.6677	4.9177	5.1677	5.4177	5.6677	5.9177
		Max X..	2.9188	3.1688	3.4188	3.6688	3.9188	4.1688	4.4188	4.6688	4.9188	5.1688	5.4188	5.6688	5.9188
		Min.X..	2.9183	3.1683	3.4183	3.6683	3.9183	4.1682	4.4182	4.6682	4.9182	5.1682	5.4182	5.6682	5.9182
Minor diameter of ring gage.....	Classes 2 and 3.	Max....	2.8647	3.1147	3.3647	3.6147	3.8647	4.1147	4.3647	4.6147	4.8647	5.1147	5.3647	5.6147	5.8647
		Min....	2.8640	3.1140	3.3640	3.6140	3.8640	4.1136	4.3636	4.6136	4.8636	5.1136	5.3636	5.6136	5.8636
"Not Go" Gages for Screws															
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Classes 2 and 3.	Min....	3.0000	3.2500	3.5000	3.7500	4.0000	4.2500	4.5000	4.7500	5.0000	5.2500	5.5000	5.7500	6.0000
		Max....	3.0007	3.2507	3.5007	3.7507	4.0007	4.2511	4.5011	4.7511	5.0011	5.2511	5.5011	5.7511	6.0011
Major diameter of truncated portion of truncated setting plug.	Class 2..	Min....	2.9592	3.2090	3.4589	3.7088	3.9587	4.2081	4.4580	4.7079	4.9578	5.2077	5.4576	5.7075	5.9574
		Max....	2.9599	3.2097	3.4596	3.7095	3.9594	4.2092	4.4591	4.7090	4.9589	5.2088	5.4587	5.7086	5.9585
	Class 3..	Min....	2.9630	3.2129	3.4629	3.7128	3.9627	4.2122	4.4621	4.7120	4.9619	5.2119	5.4618	5.7117	5.9616
		Max....	2.9637	3.2136	3.4636	3.7135	3.9634	4.2133	4.4632	4.7131	4.9630	5.2130	5.4629	5.7128	5.9627
Pitch diameter of setting plug and ring gages for production and inspection.	Class 2..	Min....	2.9058	3.1556	3.4055	3.6554	3.9053	4.1551	4.4050	4.6549	4.9048	5.1547	5.4046	5.6545	5.9044
		Max....	2.9063	3.1561	3.4060	3.6559	3.9058	4.1557	4.4056	4.6555	4.9054	5.1553	5.4052	5.6551	5.9050
	Class 3..	Min....	2.9096	3.1595	3.4095	3.6594	3.9093	4.1592	4.4091	4.6590	4.9089	5.1589	5.4088	5.6587	5.9086
		Max....	2.9101	3.1600	3.4100	3.6599	3.9098	4.1598	4.4097	4.6596	4.9095	5.1595	5.4094	5.6593	5.9092
(Optional)															
Pitch diameter of setting plug and ring gages for inspection. (See par. 6, p. 31.)	Class 2..	Min....	2.9053	3.1551	3.4050	3.6549	3.9048	4.1545	4.4044	4.6543	4.9042	5.1541	5.4040	5.6539	5.9038
		Max....	2.9058	3.1556	3.4055	3.6554	3.9053	4.1551	4.4050	4.6549	4.9048	5.1547	5.4046	5.6545	5.9044
	Class 3..	Min....	2.9091	3.1590	3.4090	3.6589	3.9088	4.1586	4.4085	4.6584	4.9083	5.1583	5.4082	5.6581	5.9080
		Max....	2.9096	3.1595	3.4095	3.6594	3.9093	4.1592	4.4091	4.6590	4.9089	5.1589	5.4088	5.6587	5.9086
Minor diameter of ring gage.....	Class 2..	Min....	2.8787	3.1285	3.3784	3.6283	3.8782	4.1280	4.3779	4.6278	4.8777	5.1276	5.3775	5.6274	5.8773
		Max....	2.8794	3.1292	3.3791	3.6290	3.8789	4.1291	4.3790	4.6289	4.8788	5.1287	5.3786	5.6285	5.8784
	Class 3..	Min....	2.8825	3.1324	3.3824	3.6323	3.8822	4.1321	4.3820	4.6319	4.8818	5.1318	5.3817	5.6316	5.8815
		Max....	2.8832	3.1331	3.3831	3.6330	3.8829	4.1332	4.3831	4.6330	4.8829	5.1329	5.3828	5.6327	5.8826

TABLE 39.—*Limiting dimensions of thread plug gages for nuts, classes 2 and 3 fits, American National 8-pitch thread series*

Limiting dimensions			Size (inches)												
			1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2½	2¾
"Go" Gages for Nuts			*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage	Classes 2 and 3.	Min....	1.0000	1.1250	1.2500	1.3750	1.5000	1.6250	1.7500	1.8750	2.0000	2.1250	2.2500	2.5000	2.7500
		Max....	1.0007	1.1257	1.2507	1.3757	1.5007	1.6257	1.7507	1.8757	2.0007	2.1257	2.2507	2.5007	2.7507
Pitch diameter of plug gage	Classes 2 and 3.	Min Y..	0.9190	1.0440	1.1690	1.2940	1.4190	1.5440	1.6690	1.7940	1.9190	2.0440	2.1690	2.4190	2.6690
		Max Y..	.9195	1.0445	1.1695	1.2945	1.4195	1.5447	1.6697	1.7947	1.9197	2.0447	2.1697	2.4197	2.6697
		Min X..	.9188	1.0438	1.1688	1.2938	1.4188	1.5438	1.6688	1.7938	1.9188	2.0438	2.1688	2.4188	2.6688
		Max X..	.9192	1.0442	1.1692	1.2942	1.4192	1.5443	1.6693	1.7943	1.9193	2.0443	2.1693	2.4193	2.6693
"Not Go" Gages for Nuts															
Major diameter of plug gage	Class 2..	Max....	.9805	1.1058	1.2312	1.3565	1.4819	1.6072	1.7326	1.8579	1.9833	2.1086	2.2339	2.4846	2.7353
		Min....	.9798	1.1051	1.2305	1.3558	1.4812	1.6065	1.7319	1.8572	1.9826	2.1079	2.2332	2.4839	2.7346
	Class 3..	Max....	.9783	1.1034	1.2287	1.3540	1.4792	1.6044	1.7297	1.8549	1.9802	2.1054	2.2306	2.4811	2.7316
		Min....	.9776	1.1027	1.2280	1.3533	1.4785	1.6037	1.7290	1.8542	1.9795	2.1047	2.2299	2.4804	2.7309
Pitch diameter of thread plug gages for production and inspection.	Class 2..	Max....	.9264	1.0517	1.1771	1.3024	1.4278	1.5531	1.6785	1.8038	1.9292	2.0545	2.1798	2.4305	2.6812
		Min....	.9260	1.0513	1.1767	1.3020	1.4274	1.5526	1.6780	1.8033	1.9287	2.0540	2.1793	2.4300	2.6807
	Class 3..	Max....	.9242	1.0493	1.1746	1.2999	1.4251	1.5503	1.6756	1.8008	1.9261	2.0513	2.1765	2.4270	2.6775
		Min....	.9238	1.0489	1.1742	1.2995	1.4247	1.5498	1.6751	1.8003	1.9256	2.0508	2.1760	2.4265	2.6770
(OPTIONAL)															
Pitch diameter of thread plug gages for inspection. (See par. 6, p. 31.)	Class 2..	Max....	.9268	1.0521	1.1775	1.3028	1.4282	1.5536	1.6790	1.8043	1.9297	2.0550	2.1803	2.4310	2.6817
		Min....	.9264	1.0517	1.1771	1.3024	1.4278	1.5531	1.6785	1.8038	1.9292	2.0545	2.1798	2.4305	2.6812
	Class 3..	Max....	.9246	1.0497	1.1750	1.3003	1.4255	1.5508	1.6761	1.8013	1.9266	2.0518	2.1770	2.4275	2.6780
		Min....	.9242	1.0493	1.1746	1.2999	1.4251	1.5503	1.6756	1.8008	1.9261	2.0513	2.1765	2.4270	2.6775

Limiting dimensions			Size (inches)												
			3	3¼	3½	3¾	4	4¼	4½	4¾	5	5¼	5½	5¾	6
"Go" Gages for Nuts			*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage	Classes 2 and 3.	Min....	3.0000	3.2500	3.5000	3.7500	4.0000	4.2500	4.5000	4.7500	5.0000	5.2500	5.5000	5.7500	6.0000
		Max....	3.0007	3.2507	3.5007	3.7507	4.0007	4.2511	4.5011	4.7511	5.0011	5.2511	5.5011	5.7511	6.0011
Pitch diameter of plug gage	Classes 2 and 3.	Min Y..	2.9190	3.1690	3.4190	3.6690	3.9190	4.1690	4.4190	4.6690	4.9190	5.1690	5.4190	5.6690	5.9190
		Max Y..	2.9197	3.1697	3.4197	3.6697	3.9197	4.1699	4.4199	4.6699	4.9199	5.1699	5.4199	5.6699	5.9199
		Min X..	2.9188	3.1688	3.4188	3.6688	3.9188	4.1688	4.4188	4.6688	4.9188	5.1688	5.4188	5.6688	5.9188
		Max X..	2.9193	3.1693	3.4193	3.6693	3.9193	4.1694	4.4194	4.6694	4.9194	5.1694	5.4194	5.6694	5.9194
"Not Go" Gages for Nuts															
Major diameter of plug gage	Class 2..	Max....	2.9859	3.2361	3.4862	3.7363	3.9864	4.2366	4.4867	4.7368	4.9869	5.2370	5.4871	5.7372	5.9873
		Min....	2.9852	3.2354	3.4855	3.7356	3.9857	4.2355	4.4856	4.7357	4.9858	5.2359	5.4860	5.7361	5.9862
	Class 3..	Max....	2.9821	3.2322	3.4822	3.7323	3.9824	4.2325	4.4826	4.7327	4.9828	5.2328	5.4829	5.7330	5.9831
		Min....	2.9814	3.2315	3.4815	3.7316	3.9817	4.2314	4.4815	4.7316	4.9817	5.2317	5.4818	5.7319	5.9820
Pitch diameter of thread plug gages for production and inspection.	Class 2..	Max....	2.9318	3.1820	3.4321	3.6822	3.9323	4.1825	4.4326	4.6827	4.9328	5.1829	5.4330	5.6831	5.9332
		Min....	2.9313	3.1815	3.4316	3.6817	3.9318	4.1819	4.4320	4.6821	4.9322	5.1823	5.4324	5.6825	5.9326
	Class 3..	Max....	2.9280	3.1781	3.4281	3.6782	3.9283	4.1784	4.4285	4.6786	4.9287	5.1787	5.4288	5.6789	5.9290
		Min....	2.9275	3.1776	3.4276	3.6777	3.9278	4.1778	4.4279	4.6780	4.9281	5.1781	5.4282	5.6783	5.9284
(OPTIONAL)															
Pitch diameter of thread plug gages for inspection. (See par. 6, p. 31.)	Class 2..	Max....	2.9323	3.1825	3.4326	3.6827	3.9328	4.1831	4.4332	4.6833	4.9334	5.1835	5.4336	6.6837	5.9338
		Min....	2.9318	3.1820	3.4321	3.6822	3.9323	4.1825	4.4326	4.6827	4.9328	5.1829	5.4330	5.6831	5.9332
	Class 3..	Max....	2.9285	3.1786	3.4286	3.6787	3.9288	4.1790	4.4291	4.6792	4.9293	5.1793	5.4294	5.6795	5.9296
		Min....	2.9280	3.1781	3.4281	3.6782	3.9283	4.1784	4.4285	4.6786	4.9287	5.1787	5.4288	5.6789	5.9290

TABLE 40.—*Limiting dimensions of Y plain gages for screws and nuts of classes 2 and 3 fits, American National 8-pitch thread series*

Size	Gages for major diameter of screw				Gages for minor diameter of nut			
	"Go" gage		"Not go" gage		"Go" gage		"Not go" gage	
	Maximum	Minimum	Minimum	Maximum	Minimum	Maximum	Maximum	Minimum
1	2	3	4	5	6	7	8	9
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1	1.00000	0.99991	0.98480	0.98489	0.86470	0.86479	0.87950	0.87941
1⅛	1.12500	1.12491	1.10980	1.10989	.98970	.98979	1.00450	1.00441
1¼	1.25000	1.24991	1.23480	1.23489	1.11470	1.11479	1.12950	1.12941
1⅜	1.37500	1.37491	1.35980	1.35989	1.23970	1.23979	1.25450	1.25441
1½	1.50000	1.49991	1.48480	1.48489	1.36470	1.36479	1.37950	1.37941
1⅝	1.62500	1.62488	1.60980	1.60992	1.48970	1.48979	1.50450	1.50441
1¾	1.75000	1.74988	1.73480	1.73492	1.61470	1.61482	1.62950	1.62938
1⅞	1.87500	1.87488	1.85980	1.85992	1.73970	1.73982	1.75450	1.75438
2	2.00000	1.99988	1.98480	1.98492	1.86470	1.86482	1.87950	1.87938
2⅛	2.12500	2.12488	2.10980	2.10992	1.98970	1.98982	2.00450	2.00438
2¼	2.25000	2.24988	2.23480	2.23492	2.11470	2.11482	2.12950	2.12938
2½	2.50000	2.49988	2.48480	2.48492	2.36470	2.36482	2.37950	2.37938
2¾	2.75000	2.74985	2.73480	2.73495	2.61470	2.61485	2.62950	2.62935
3	3.00000	2.99985	2.98480	2.98495	2.86470	2.86485	2.87950	2.87935
3¼	3.25000	3.24985	3.23480	3.23495	3.11470	3.11485	3.12950	3.12935
3½	3.50000	3.49985	3.48480	3.48495	3.36470	3.36485	3.37950	3.37935
3¾	3.75000	3.74985	3.73480	3.73495	3.61470	3.61485	3.62950	3.62935
4	4.00000	3.99985	3.98480	3.98495	3.86470	3.86485	3.87950	3.87935
4¼	4.25000	4.24985	4.23480	4.23495	4.11470	4.11485	4.12950	4.12935
4½	4.50000	4.44985	4.48480	4.48495	4.36470	4.36485	4.37950	4.37935
4¾	4.75000	4.74981	4.73480	4.73499	4.61470	4.61489	4.62950	4.62931
5	5.00000	4.99981	4.98480	4.98499	4.86470	4.86489	4.87950	4.87931
5¼	5.25000	5.24981	5.23480	5.23499	5.11470	5.11489	5.12950	5.12931
5½	5.50000	5.49981	5.48480	5.48499	5.36470	5.36489	5.37950	5.37931
5¾	5.75000	5.74981	5.73480	5.73499	5.61470	5.61489	5.62950	5.62931
6	6.00000	5.99981	5.98480	5.98499	5.86470	5.86489	5.87950	5.87931

TABLE 41.—*Sizes of tap drills, American National 8-pitch thread series*

Size of thread	Threads per inch	Minor diameter of nut			Stock drills and corresponding percentage of basic thread depth		
		Basic	Maximum	Minimum	Nominal size	Diameter	Percentage of depth of basic thread
		Inches	*Inches*	*Inches*		*Inches*	
1	8	0.8376	0.8795	0.8647	22 mm	0.8661	82
					7/8 in.	.8750	77
1⅛	8	.9626	1.0045	.9897	1 in.	1.0000	77
					25.5 mm	1.0039	75
1¼	8	1.0876	1.1295	1.1147	28.5 mm	1.1220	79
					1⅛ in.	1.1250	77
1⅜	8	1.2126	1.2545	1.2397	31.5 mm	1.2402	83
					1¼ in.	1.2500	77
1½	8	1.3376	1.3795	1.3647	1⅜ in.	1.3750	77
					35 mm	1.3780	75
1⅝	8	1.4626	1.5045	1.4897	38 mm	1.4961	79
					1½ in.	1.5000	77
1¾	8	1.5876	1.6295	1.6147	1⅝ in.	1.6250	77
1⅞	8	1.7126	1.7545	1.7397	1¾ in.	1.7500	77
					44.5 mm	1.7520	76
2	8	1.8376	1.8795	1.8647	47.5 mm	1.8701	80
					1⅞ in.	1.8750	77
2⅛	8	1.9626	2.0045	1.9897	2 in.	2.0000	77
2¼	8	2.0876	2.1295	2.1147	2⅛ in.	2.1250	77
					54 mm	2.1260	76
2½	8	2.3376	2.3795	2.3647	2⅜ in.	2.3750	77
2¾	8	2.5876	2.6295	2.6147	66.5 mm	2.6181	81
					2⅝ in.	2.6250	77
3	8	2.8376	2.8795	2.8647	73 mm	2.8740	78
					2⅞ in.	2.8750	77
3¼	8	3.0876	3.1295	3.1147	3⅛ in.	3.1250	77
3½	8	3.3376	3.3795	3.3647	3⅜ in.	3.3750	77

6. AMERICAN NATIONAL 12-PITCH THREAD SERIES

The nominal sizes and basic dimensions of the "American National 12-pitch thread series" are specified in table 15, p. 45.

Sizes of 12-pitch threads from one half inch to and including one and three fourths inches are used in boiler practice, which requires that worn stud holes be retapped with a tap of the next larger size, the increment being one sixteenth inch throughout most of the range. Die-head chasers for sizes up to 3 inches are stocked by manufacturers.[13]

The 12-pitch threads are also widely used in machine construction, as for thin nuts on shafts and sleeves. From the standpoints of good design and simplification of practice, it is desirable to limit shoulder diameters to one-eighth-inch steps. The 12 pitch is the coarsest in general use, which will permit a threaded collar which screws onto a threaded shoulder to slip over a shaft, the difference in diameter between shoulder and shaft being one-eighth inch.

Limiting dimensions for the American National 12-pitch thread series, classes 2 and 3, are given in table 42, the limiting dimensions of thread gages in tables 43, 44, and 45, and of tap drill sizes in table 46.

Threads of the American National 12-pitch thread series are designated by the symbol "12N." Example:

Threaded part 1 inch diameter, 12 threads per inch, class 3 fit, mark.....*1"-12N-3*

[13] See National Bureau of Standards Simplified Practice Recommendation R51-29, Die Head Chasers.

TABLE 42.—*Limiting dimensions and tolerances, classes 2 and 3 fits, American National 12-pitch thread series*

Dimensions and tolerances[1]		Size (inches)							
		½	9/16[2]	⅝	11/16	¾	13/16	⅞	15/16
BOLTS AND SCREWS		*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
Classes 2 and 3, major diameter.....	Max...	0.5000	0.5625	0.6250	0.6875	0.7500	0.8125	0.8750	0.9375
	Min...	.4888	.5513	.6138	.6763	.7388	.8013	.8638	.9263
	Tol...	.0112	.0112	.0112	.0112	.0112	.0112	.0112	.0112
Classes 2 and 3, minor diameter.....	Max[4]..	.3978	.4603	.5228	.5853	.6478	.7103	.7728	.8353
Class 2, pitch diameter (for general use).	Max[6]..	.4459	.5084	.5709	.6334	.6959	.7584	.8209	.8834
	Min...	.4403	.5028	.5653	.6278	.6903	.7528	.8153	.8778
	Tol...	.0056	.0056	.0056	.0056	.0056	.0056	.0056	.0056
Class 3, pitch diameter.....	Max[6]..	.4459	.5084	.5709	.6334	.6959	.7584	.8209	.8834
	Min...	.4419	.5044	.5669	.6294	.6919	.7544	.8169	.8794
	Tol...	.0040	.0040	.0040	.0040	.0040	.0040	.0040	.0040
NUTS AND TAPPED HOLES									
Classes 2 and 3, major diameter.....	Min[5]..	.5000	.5625	.6250	.6875	.7500	.8125	.8750	.9375
Classes 2 and 3, minor diameter.....	Min...	.4098	.4723	.5348	.5973	.6598	.7223	.7848	.8473
	Max...	.4225	.4850	.5438	.6063	.6688	.7313	.7938	.8563
	Tol...	.0127	.0127	.0090	.0090	.0090	.0090	.0090	.0090
Classes 2 and 3, pitch diameter.....	Min[6]..	.4459	.5084	.5709	.6334	.6959	.7584	.8209	.8834
Class 2, pitch diameter (for general use).	Max...	.4515	.5140	.5765	.6390	.7015	.7640	.8265	.8890
	Tol...	.0056	.0056	.0056	.0056	.0056	.0056	.0056	.0056
Class 3, pitch diameter.....	Max...	.4499	.5124	.5749	.6374	.6999	.7624	.8249	.8874
	Tol...	.0040	.0040	.0040	.0040	.0040	.0040	.0040	.0040

See footnotes at end of table.

TABLE 42.—*Limiting dimensions and tolerances, classes 2 and 3 fits, American National 12-pitch thread series*—Continued

Dimensions and tolerances[1]		Size (inches)						
		1	1 1/16	1 1/8[3]	1 3/16	1 1/4[3]	1 5/16	1 3/8[3]
BOLTS AND SCREWS		*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Classes 2 and 3, major diameter.....	Max...	1.0000	1.0625	1.1250	1.1875	1.2500	1.3125	1.3750
	Min...	.9888	1.0513	1.1138	1.1763	1.2388	1.3013	1.3638
	Tol...	.0112	.0112	.0112	.0112	.0112	.0112	.0112
Classes 2 and 3, minor diameter.....	Max[4]..	.8978	.9603	1.0228	1.0853	1.1478	1.2103	1.2728
Class 2, pitch diameter (for general use).	Max[6]..	.9459	1.0084	1.0709	1.1334	1.1959	1.2584	1.3209
	Min...	.9403	1.0028	1.0653	1.1278	1.1903	1.2528	1.3153
	Tol...	.0056	.0056	.0056	.0056	.0056	.0056	.0056
Class 3, pitch diameter.....	Max[6]..	.9459	1.0084	1.0709	1.1334	1.1959	1.2584	1.3209
	Min...	.9419	1.0044	1.0669	1.1294	1.1919	1.2544	1.3169
	Tol...	.0040	.0040	.0040	.0040	.0040	.0040	.0040
NUTS AND TAPPED HOLES								
Classes 2 and 3, major diameter.....	Min[5]..	1.0000	1.0625	1.1250	1.1875	1.2500	1.3125	1.3750
Classes 2 and 3, minor diameter.....	Min...	.9098	.9723	1.0348	1.0973	1.1598	1.2223	1.2848
	Max...	.9188	.9813	1.0438	1.1063	1.1688	1.2313	1.2938
	Tol...	.0090	.0090	.0090	.0090	.0090	.0090	.0090
Classes 2 and 3, pitch diameter.....	Min[6]..	.9459	1.0084	1.0709	1.1334	1.1959	1.2584	1.3209
Class 2, pitch diameter (for general use).	Max...	.9515	1.0140	1.0765	1.1390	1.2015	1.2640	1.3265
	Tol...	.0056	.0056	.0056	.0056	.0056	.0056	.0056
Class 3, pitch diameter.....	Max...	.9499	1.0124	1.0749	1.1374	1.1999	1.2624	1.3249
	Tol...	.0040	.0040	.0040	.0040	.0040	.0040	.0040

Dimensions and tolerances[1]		Size (inches)						
		1 7/16	1 1/2[3]	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4
BOLTS AND SCREWS		*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Classes 2 and 3, major diameter.....	Max...	1.4375	1.5000	1.6250	1.7500	1.8750	2.0000	2.1250	2.2500
	Min...	1.4263	1.4888	1.6138	1.7388	1.8638	1.9888	2.1138	2.2388
	Tol...	.0112	.0112	.0112	.0112	.0112	.0112	.0112	.0112
Classes 2 and 3, minor diameter.....	Max[4]..	1.3353	1.3978	1.5228	1.6478	1.7728	1.8978	2.0228	2.1478
Class 2, pitch diameter (for general use).	Max[6]..	1.3834	1.4459	1.5709	1.6959	1.8209	1.9459	2.0709	2.1959
	Min...	1.3778	1.4403	1.5645	1.6894	1.8143	1.9392	2.0641	2.1890
	Tol...	.0056	.0056	.0064	.0065	.0066	.0067	.0068	.0069
Class 3, pitch diameter.....	Max[6]..	1.3834	1.4459	1.5709	1.6959	1.8209	1.9459	2.0709	2.1959
	Min...	1.3794	1.4419	1.5664	1.6913	1.8163	1.9412	2.0661	2.1911
	Tol...	.0040	.0040	.0045	.0046	.0046	.0047	.0048	.0048
NUTS AND TAPPED HOLES									
Classes 2 and 3, major diameter.....	Min[5]..	1.4375	1.5000	1.6250	1.7500	1.8750	2.0000	2.1250	2.2500
Classes 2 and 3, minor diameter.....	Min...	1.3473	1.4098	1.5348	1.6598	1.7848	1.9098	2.0348	2.1598
	Max...	1.3563	1.4188	1.5438	1.6688	1.7938	1.9188	2.0438	2.1688
	Tol...	.0090	.0090	.0090	.0090	.0090	.0090	.0090	.0090
Classes 2 and 3, pitch diameter.....	Min[6]..	1.3834	1.4459	1.5709	1.6959	1.8209	1.9459	2.0709	2.1959
Class 2, pitch diameter (for general use).	Max...	1.3890	1.4515	1.5773	1.7024	1.8275	1.9526	2.0777	2.2028
	Tol...	.0056	.0056	.0064	.0065	.0066	.0067	.0068	.0069
Class 3, pitch diameter.....	Max...	1.3874	1.4499	1.5754	1.7005	1.8255	1.9506	2.0757	2.2007
	Tol...	.0040	.0040	.0045	.0046	.0046	.0047	.0048	.0048

See footnotes at end of table.

TABLE 42.—*Limiting dimensions and tolerances, classes 2 and 3 fits, American National 12-pitch thread series*—Continued

Dimensions and tolerances[1]	Size (inches)						
	2⅜	2½	2⅝	2¾	2⅞	3	3⅛
BOLTS AND SCREWS	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Classes 2 and 3, major diameter..... Max...	2.3750	2.5000	2.6250	2.7500	2.8750	3.0000	3.1250
Min...	2.3638	2.4888	2.6138	2.7388	2.8638	2.9888	3.1138
Tol...	.0112	.0112	.0112	.0112	.0112	.0112	.0112
Classes 2 and 3, minor diameter..... Max[4]..	2.2728	2.3978	2.5228	2.6478	2.7728	2.8978	3.0228
Class 2, pitch diameter (for general use). Max[6]..	2.3209	2.4459	2.5709	2.6959	2.8209	2.9459	3.0709
Min...	2.3139	2.4388	2.5638	2.6887	2.8136	2.9385	3.0635
Tol...	.0070	.0071	.0071	.0072	.0073	.0074	.0074
Class 3, pitch diameter..... Max[6]..	2.3209	2.4459	2.5709	2.6959	2.8209	2.9459	3.0709
Min...	2.3160	2.4410	2.5659	2.6909	2.8158	2.9408	3.0657
Tol...	.0049	.0049	.0050	.0050	.0051	.0051	.0052
NUTS AND TAPPED HOLES							
Classes 2 and 3, major diameter..... Min[5]..	2.3750	2.5000	2.6250	2.7500	2.8750	3.0000	3.1250
Classes 2 and 3, minor diameter..... Min...	2.2848	2.4098	2.5348	2.6598	2.7848	2.9098	3.0348
Max...	2.2938	2.4188	2.5438	2.6688	2.7938	2.9188	3.0438
Tol...	.0090	.0090	.0090	.0090	.0090	.0090	.0090
Classes 2 and 3, pitch diameter..... Min[6]..	2.3209	2.4459	2.5709	2.6959	2.8209	2.9459	3.0709
Class 2, pitch diameter (for general use). Max...	2.3279	2.4530	2.5780	2.7031	2.8282	2.9533	3.0783
Tol...	.0070	.0071	.0071	.0072	.0073	.0074	.0074
Class 3, pitch diameter..... Max...	2.3258	2.4508	2.5759	2.7009	2.8260	2.9510	3.0761
Tol...	.0049	.0049	.0050	.0050	.0051	.0051	.0052

Dimensions and tolerances[1]	Size (inches)							
	3¼	3⅜	3½	3⅝	3¾	3⅞	4	4¼
BOLTS AND SCREWS	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Classes 2 and 3, major diameter..... Max...	3.2500	3.3750	3.5000	3.6250	3.7500	3.8750	4.0000	4.2500
Min...	3.2388	3.3638	3.4888	3.6138	3.7388	3.8638	3.9888	4.2388
Tol...	.0112	.0112	.0112	.0112	.0112	.0112	.0112	.0112
Classes 2 and 3, minor diameter..... Max[4]..	3.1478	3.2728	3.3978	3.5228	3.6478	3.7728	3.8978	4.1478
Class 2, pitch diameter (for general use). Max[6]..	3.1959	3.3209	3.4459	3.5709	3.6959	3.8209	3.9459	4.1959
Min...	3.1884	3.3133	3.4383	3.5632	3.6881	3.8131	3.9380	4.1879
Tol...	.0075	.0076	.0076	.0077	.0078	.0078	.0079	.0080
Class 3, pitch diameter..... Max[6]..	3.1959	3.3209	3.4459	3.5709	3.6959	3.8209	3.9459	4.1959
Min...	3.1907	3.3156	3.4406	3.5655	3.6905	3.8154	3.9404	4.1903
Tol...	.0052	.0053	.0053	.0054	.0054	.0055	.0055	.0056
NUTS AND TAPPED HOLES								
Classes 2 and 3, major diameter..... Min[5]..	3.2500	3.3750	3.5000	3.6250	3.7500	3.8750	4.0000	4.2500
Classes 2 and 3, minor diameter..... Min...	3.1598	3.2848	3.4098	3.5348	3.6598	3.7848	3.9098	4.1598
Max...	3.1688	3.2938	3.4188	3.5438	3.6688	3.7938	3.9188	4.1688
Tol...	.0090	.0090	.0090	.0090	.0090	.0090	.0090	.0090
Classes 2 and 3, pitch diameter..... Min[6]..	3.1959	3.3209	3.4459	3.5709	3.6959	3.8209	3.9459	4.1959
Class 2, pitch diameter (for general use). Max...	3.2034	3.3285	3.4535	3.5786	3.7037	3.8287	3.9538	4.2039
Tol...	.0075	.0076	.0076	.0077	.0078	.0078	.0079	.0080
Class 3, pitch diameter..... Max...	3.2011	3.3262	3.4512	3.5763	3.7013	3.8264	3.9514	4.2015
Tol...	.0052	.0053	.0053	.0054	.0054	.0055	.0055	.0056

See footnotes at end of table.

TABLE 42.—*Limiting dimensions and tolerances, classes 2 and 3 fits, American National 12-pitch thread series*—Continued

Dimensions and tolerances[1]		Size (inches)						
		4½	4¾	5	5¼	5½	5¾	6
BOLTS AND SCREWS		*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Classes 2 and 3, major diameter.....	Max...	4.5000	4.7500	5.0000	5.2500	5.5000	5.7500	6.0000
	Min...	4.4888	4.7388	4.9888	5.2388	5.4888	5.7388	5.9888
	Tol...	.0112	.0112	.0112	.0112	.0112	.0112	.0112
Classes 2 and 3, minor diameter.....	Max[4]..	4.3978	4.6478	4.8978	5.1478	5.3978	5.6478	5.8978
Class 2, pitch diameter (for general use).	Max[6]..	4.4459	4.6959	4.9459	5.1959	5.4459	5.6959	5.9459
	Min...	4.4378	4.6876	4.9375	5.1874	5.4373	5.6872	5.9371
	Tol...	.0081	.0083	.0084	.0085	.0086	.0087	.0088
Class 3, pitch diameter.....	Max[6]..	4.4459	4.6959	4.9459	5.1959	5.4459	5.6959	5.9459
	Min...	4.4402	4.6901	4.9400	5.1900	5.4399	5.6898	5.9397
	Tol...	.0057	.0058	.0059	.0059	.0060	.0061	.0062
NUTS AND TAPPED HOLES								
Classes 2 and 3, major diameter.....	Min[5]..	4.5000	4.7500	5.0000	5.2500	5.5000	5.7500	6.0000
Classes 2 and 3, minor diameter.....	Min...	4.4098	4.6598	4.9098	5.1598	5.4098	5.6598	5.9098
	Max...	4.4188	4.6688	4.9188	5.1688	5.4188	5.6688	5.9188
	Tol...	.0090	.0090	.0090	.0090	.0090	.0090	.0090
Classes 2 and 3, pitch diameter.....	Min[6]..	4.4459	4.6959	4.9459	5.1959	5.4459	5.6959	5.9459
Class 2, pitch diameter (for general use).	Max...	4.4540	4.7042	4.9543	5.2044	5.4545	5.7046	5.9547
	Tol...	.0081	.0083	.0084	.0085	.0086	.0087	.0088
Class 3, pitch diameter.....	Max...	4.4516	4.7017	4.9518	5.2018	5.4519	5.7020	5.9521
	Tol...	.0057	.0058	.0059	.0059	.0060	.0061	.0062

[1] Pitch diameter tolerances include errors of lead and angle. The class 2 tolerances for sizes above 1½ inches are based on the formulas in table 143 and a length of engagement of 6 threads or ½ inch. The class 3 tolerances are 70 percent of the class 2 tolerances. For lengths of engagement of 1 inch, 0.0010 inch may be added to these tolerances. As certain sizes up to 1½ inches are included in the American National coarse or fine thread series, the tolerances to and including 1½ inches correspond to those series.

[2] Standard size screw and nut of the American National coarse thread series.

[3] Standard size screw and nut of the American National fine thread series.

[4] Dimensions given for the maximum minor diameter of the screw are figured to the intersection of the worn tool arc with a center line through crest and root. The minimum minor diameter of the screw shall be that corresponding to a flat at the minor diameter of the minimum screw equal to $\frac{1}{8} \times p$, and may be determined by subtracting 0.0541 inch from the minimum pitch diameter of the screw.

[5] Dimensions for the minimum major diameter of the nut correspond to the basic flat ($\frac{1}{8} \times p$) and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the nut shall be that corresponding to a flat at the major diameter of the maximum nut equal to $\frac{1}{24} \times p$, and may be determined by adding 0.0662 inch to the maximum pitch diameter of the nut.

[6] These dimensions are the maximum metal or "go" size, and are those which should be placed on the component drawing with the tolerances.

TABLE 43.—*Limiting dimensions of setting plug and thread ring gages for screws of classes 2 and 3 fits, American National 12-pitch thread series*

Limiting dimensions			Size (inches)													
			½	9/16	5/8	1 1/16	¾	13/16	⅞	15/16	1	1 1/16	1 1/8	1 3/16	1 1/4	1 5/16	1 3/8
"GO" GAGES FOR SCREWS																	
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Classes 2 and 3.	Max....	*Inch* 0.5006	*Inch* 0.5631	*Inch* 0.6256	*Inch* 0.6881	*Inch* 0.7506	*Inch* 0.8131	*Inch* 0.8756	*Inch* 0.9381	*Inches* 1.0006	*Inches* 1.0631	*Inches* 1.1256	*Inches* 1.1881	*Inches* 1.2506	*Inches* 1.3131	*Inches* 1.3756
		Min....	.5000	.5625	.6250	.6875	.7500	.8125	.8750	.9375	1.0000	1.0625	1.1250	1.1875	1.2500	1.3125	1.3750
Major diameter of truncated portion of truncated setting plug.	Classes 2 and 3.	Max....	.4888	.5513	.6138	.6763	.7388	.8013	.8638	.9263	.9888	1.0513	1.1138	1.1763	1.2388	1.3013	1.3638
		Min....	.4882	.5507	.6132	.6757	.7382	.8007	.8632	.9257	.9882	1.0507	1.1132	1.1757	1.2382	1.3007	1.3632
Pitch diameter of setting plug or ring gage.	Classes 2 and 3.	Max Y..	.4457	.5082	.5707	.6332	.6957	.7582	.8207	.8832	.9457	1.0082	1.0707	1.1332	1.1957	1.2582	1.3207
		Min Y..	.4453	.5078	.5703	.6328	.6953	.7578	.8203	.8828	.9453	1.0078	1.0703	1.1328	1.1953	1.2578	1,3203
		Max X..	.4459	.5084	.5709	.6334	.6959	.7584	.8209	.8834	.9459	1.0084	1.0709	1.1334	1.1959	1.2584	1.3209
		Min X..	.4456	.5081	.5706	.6331	.6956	.7581	.8206	.8831	.9456	1.0081	1.0706	1.1331	1.1956	1.2581	1.3206
Minor diameter of ring gage.....	Classes 2 and 3.	Max....	.4098	.4723	.5348	.5973	.6598	.7223	.7848	.8473	.9098	0.9723	1.0348	1.0973	1.1598	1.2223	1.2848
		Min....	.4092	.4717	.5342	.5967	.6592	.7217	.7842	.8467	.9092	.9717	1.0342	1.0967	1.1592	1.2217	1.2842
"NOT GO" GAGES FOR SCREWS																	
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Classes 2 and 3.	Min....	.5000	.5625	.6250	.6875	.7500	.8125	.8750	.9375	1.0000	1.0625	1.1250	1.1875	1.2500	1.3125	1.3750
		Max....	.5006	.5631	.6256	.6881	.7506	.8131	.8756	.9381	1.0006	1.0631	1.1256	1.1881	1.2506	1.3131	1.3756
Major diameter of truncated portion of truncated setting plug.	Class 2..	Min....	.4758	.5383	.6008	.6633	.7258	.7883	.8508	.9133	.9758	1.0383	1.1008	1.1633	1.2258	1.2883	1.3508
		Max....	.4764	.5389	.6014	.6639	.7264	.7889	.8514	.9139	.9764	1.0389	1.1014	1.1639	1.2264	1.2889	1.3514
	Class 3..	Min....	.4774	.5399	.6024	.6649	.7274	.7899	.8524	.9149	.9774	1.0399	1.1024	1.1649	1.2274	1.2899	1.3524
		Max....	.4780	.5405	.6030	.6655	.7280	.7905	.8530	.9155	.9780	1.0405	1.1030	1.1655	1.2280	1.2905	1.3530
Pitch diameter of setting plug or ring gages for production and inspection.	Class 2..	Min....	.4403	.5028	.5653	.6278	.6903	.7528	.8153	.8778	.9403	1.0028	1.0653	1.1278	1.1903	1.2528	1.3153
		Max....	.4406	.5031	.5656	.6281	.6906	.7531	.8156	.8781	.9406	1.0031	1.0656	1.1281	1.1906	1.2531	1.3156
	Class 3..	Min....	.4419	.5044	.5669	.6294	.6919	.7544	.8169	.8794	.9419	1.0044	1.0669	1.1294	1.1919	1.2544	1.3169
		Max....	.4422	.5047	.5672	.6297	.6922	.7547	.8172	.8797	.9422	1.0047	1.0672	1.1297	1.1922	1.2547	1.3172
(OPTIONAL)																	
Pitch diameter of setting plug or ring gages for inspection (see par. 6. p. 31).	Class 2..	Min....	.4400	.5025	.5650	.6275	.6900	.7525	.8150	.8775	.9400	1.0025	1.0650	1.1275	1.1900	1.2525	1.3150
		Max....	.4403	.5028	.5653	.6278	.6903	.7528	.8153	.8778	.9403	1.0028	1.0653	1.1278	1.1903	1.2528	1.3153
	Class 3..	Min....	.4416	.5041	.5666	.6291	.6916	.7541	.8166	.8791	.9416	1.0041	1.0666	1.1291	1.1916	1.2541	1.3166
		Max....	.4419	.5044	.5669	.6294	.6919	.7544	.8169	.8794	.9419	1.0044	1.0669	1.1294	1.1919	1.2544	1.3169
Minor diameter or ring gage.....	Class 2..	Min....	.4223	.4848	.5473	.6098	.6723	.7348	.7973	.8598	.9223	0.9848	1.0473	1.1098	1.1723	1.2348	1.2973
		Max....	.4229	.4854	.5479	.6104	.6729	.7354	.7979	.8604	.9229	.9854	1.0479	1.1104	1.1729	1.2354	1.2979
	Class 3..	Min....	.4239	.4864	.5489	.6114	.6739	.7364	.7989	.8614	.9239	.9864	1.0489	1.1114	1.1739	1.2364	1.2989
		Max....	.4245	.4870	.5495	.6120	.6745	.7370	.7995	.8620	.9245	.9870	1.0495	1.1120	1.1745	1.2370	1.2995

Limiting dimensions			Size (inches)													
			1 7/16	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3	3 1/8
"GO" GAGES FOR SCREWS																	
			Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Classes 2 and 3.	Max....	1.4381	1.5006	1.6256	1.7506	1.8756	2.0006	2.1256	2.2506	2.3756	2.5006	2.6256	2.7506	2.8756	3.0006	3.1256
		Min....	1.4375	1.5000	1.6250	1.7500	1.8750	2.0000	2.1250	2.2500	2.3750	2.5000	2.6250	2.7500	2.8750	3.0000	3.1250
Major diameter of truncated portion of truncated setting plug.	Classes 2 and 3.	Max....	1.4263	1.4888	1.6138	1.7388	1.8638	1.9888	2.1138	2.2388	2.3638	2.4888	2.6138	2.7388	2.8638	2.9888	3.1138
		Min....	1.4257	1.4882	1.6132	1.7382	1.8632	1.9882	2.1132	2.2382	2.3632	2.4882	2.6132	2.7382	2.8632	2.9882	3.1132
Pitch diameter of setting plug or ring gage.	Classes 2 and 3.	Max Y..	1.3832	1.4457	1.5707	1.6957	1.8207	1.9457	2.0707	2.1957	2.3207	2.4457	2.5707	2.6957	2.8207	2.9457	3.0707
		Min Y..	1.3828	1.4453	1.5701	1.6951	1.8201	1.9451	2.0701	2.1951	2.3201	2.4451	2.5701	2.6951	2.8201	2.9451	3.0701
		Max X..	1.3834	1.4459	1.5709	1.6959	1.8209	1.9459	2.0709	2.1959	2.3209	2.4459	2.5709	2.6959	2.8209	2.9459	3.0709
		Min X..	1.3831	1.4456	1.5705	1.6955	1.8205	1.9455	2.0705	2.1955	2.3205	2.4455	2.5705	2.6955	2.8205	2.9455	3.0705
Minor diameter of ring gage.....	Classes 2 and 3.	Max....	1.3473	1.4098	1.5348	1.6598	1.7848	1.9098	2.0348	2.1598	2.2848	2.4098	2.5348	2.6598	2.7848	2.9098	3.0348
		Min....	1.3467	1.4092	1.5342	1.6592	1.7842	1.9092	2.0342	2.1592	2.2842	2.4092	2.5342	2.6592	2.7842	2.9092	3.0342
"NOT GO" GAGES FOR SCREWS																	
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Classes 2 and 3.	Min....	1.4375	1.5000	1.6250	1.7500	1.8750	2.0000	2.1250	2.2500	2.3750	2.5000	2.6250	2.7500	2.8750	3.0000	3.1250
		Max....	1.4381	1.5006	1.6256	1.7506	1.8756	2.0006	2.1256	2.2506	2.3756	2.5006	2.6256	2.7506	2.8756	3.0006	3.1256
Major diameter of truncated portion of truncated setting plug.	Class 2..	Min....	1.4133	1.4758	1.6000	1.7249	1.8498	1.9747	2.0996	2.2245	2.3494	2.4743	2.5993	2.7242	2.8491	2.9740	3.0990
		Max....	1.4139	1.4764	1.6006	1.7255	1.8504	1.9753	2.1002	2.2251	2.3500	2.4749	2.5999	2.7248	2.8497	2.9746	3.0996
	Class 3..	Min....	1.4149	1.4774	1.6019	1.7268	1.8518	1.9767	2.1016	2.2266	2.3515	2.4765	2.6014	2.7264	2.8513	2.9763	3.1012
		Max....	1.4155	1.4780	1.6025	1.7274	1.8524	1.9773	2.1022	2.2272	2.3521	2.4771	2.6020	2.7270	2.8519	2.9769	3.1018
Pitch diameter of setting plug or ring gages for production and inspection.	Class 2..	Min....	1.3778	1.4403	1.5645	1.6894	1.8143	1.9392	2.0641	2.1890	2.3139	2.4388	2.5638	2.6887	2.8136	2.9385	3.0635
		Max....	1.3781	1.4406	1.5649	1.6898	1.8147	1.9396	2.0645	2.1894	2.3143	2.4392	2.5642	2.6891	2.8140	2.9389	3.0639
	Class 3..	Min....	1.3794	1.4419	1.5664	1.6913	1.8163	1.9412	2.0661	2.1911	2.3160	2.4410	2.5659	2.6909	2.8158	2.9408	3.0657
		Max....	1.3797	1.4422	1.5668	1.6917	1.8167	1.9416	2.0665	2.1915	2.3164	2.4414	2.5663	2.6913	2.8162	2.9412	3.0661
(OPTIONAL)																	
Pitch diameter of setting plug or ring gages for production (see par. 6, p. 31).	Class 2..	Min....	1.3775	1.4400	1.5641	1.6890	1.8139	1.9388	2.0637	2.1886	2.3135	2.4384	2.5634	2.6883	2.8132	2.9381	3.0631
		Max....	1.3778	1.4403	1.5645	1.6894	1.8143	1.9392	2.0641	2.1890	2.3139	2.4388	2.5638	2.6887	2.8136	2.9385	3.0635
	Class 3..	Min....	1.3791	1.4416	1.5660	1.6909	1.8159	1.9408	2.0657	2.1907	2.3156	2.4406	2.5655	2.6905	2.8154	2.9404	3.0653
		Max....	1.3794	1.4419	1.5664	1.6913	1.8163	1.9412	2.0661	2.1911	2.3160	2.4410	2.5659	2.6909	2.8158	2.9408	3.0657
Minor diameter of ring gages.....	Class 2..	Min....	1.3598	1.4223	1.5465	1.6714	1.7963	1.9212	2.0461	2.1710	2.2959	2.4208	2.5458	2.6707	2.7956	2.9205	3.0455
		Max....	1.3604	1.4229	1.5471	1.6720	1.7969	1.9218	2.0467	2.1716	2.2965	2.4214	2.5464	2.6713	2.7962	2.9211	3.0461
	Class 3..	Min....	1.3614	1.4239	1.5484	1.6733	1.7983	1.9232	2.0481	2.1731	2.2980	2.4230	2.5479	2.6729	2.7978	2.9228	3.0477
		Max.....	1.3620	1.4245	1.5490	1.6739	1.7989	1.9238	2.0487	2.1737	1.2986	2.4236	2.5485	2.6735	2.7984	2.9234	3.0483

TABLE 43.—*Limiting dimensions of setting plug and thread ring gages for screws of classes 2 and 3 fits, American National 12-pitch thread series*—Continued

Limiting dimensions			Size (inches)													
			3¼	3⅜	3½	3⅝	3¾	3⅞	4	4¼	4½	4¾	5	5¼	5½	5¾	6
"GO" GAGES FOR SCREWS																	
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Classes 2 and 3.	Max....	*Inches* 3.2506	*Inches* 3.3756	*Inches* 3.5006	*Inches* 3.6256	*Inches* 3.7506	*Inches* 3.8756	*Inches* 4.0006	*Inches* 4.2509	*Inches* 4.5009	*Inches* 4.7509	*Inches* 5.0009	*Inches* 5.2509	*Inches* 5.5009	*Inches* 5.7509	*Inches* 6.0009
		Min....	3.2500	3.3750	3.5000	3.6250	3.7500	3.8750	4.0000	4.2500	4.5000	4.7500	5.0000	5.2500	5.5000	5.7500	6.0000
Major diameter of truncated portion of truncated setting plug.	Classes 2 and 3.	Max....	3.2388	3.3638	3.4888	3.6138	3.7388	3.8638	3.9888	4.2388	4.4888	4.7388	4.9888	5.2388	5.4888	5.7388	5.9888
		Min....	3.2382	3.3632	3.4882	3.6132	3.7382	3.8632	3.9882	4.2379	4.4879	4.4379	4.9879	5.2379	5.4879	5.7379	5.9879
Pitch diameter of setting plug or ring gage.	Classes 2 and 3.	Max Y..	3.1957	3.3207	3.4457	3.5707	3.6957	3.8207	3.9457	4.1957	4.4457	4.6957	4.9457	5.1957	5.4457	5.6957	5.9457
		Min Y..	3.1951	3.3201	3.4451	3.5701	3.6951	3.8201	3.9451	4.1949	4.4449	4.6949	4.9449	5.1949	5.4449	5.6949	5.9449
		Max X..	3.1959	3.3209	3.4459	3.5709	3.6959	3.8209	3.9459	4.1959	4.4459	4.6959	4.9459	5.1959	5.4459	5.6959	5.9459
		Min X..	3.1955	3.3205	3.4455	3.5705	3.6955	3.8205	3.9455	4.1953	4.4453	4.6953	4.9453	5.1953	5.4453	5.6953	5.9453
Minor diameter of ring gage.....	Classes 2 and 3.	Max....	3.1598	3.2848	3.4098	3.5348	3.6598	3.7848	3.9098	4.1598	4.4098	4.6598	4.9098	5.1598	5.4098	5.6598	5.9098
		Min....	3.1592	3.2842	3.4092	3.5342	3.6592	3.7842	3.9092	4.1589	4.4089	4.6589	4.9089	5.1589	5.4089	5.6589	5.9089
"NOT GO" GAGES FOR SCREWS																	
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Classes 2 and 3.	Min....	3.2500	3.3750	3.5000	3.6250	3.7500	3.8750	4.0000	4.2500	4.5000	4.7500	5.0000	5.2500	5.5000	5.7500	6.0000
		Max....	3.2506	3.3756	3.5006	3.6256	3.7506	3.8756	4.0006	4.2509	4.5009	4.7509	5.0009	5.2509	5.5009	5.7509	6.0009
Major diameter of truncated portion of truncated setting plug.	Class 2..	Min....	3.2239	3.3488	3.4738	3.5987	3.7236	3.8486	3.9735	4.2231	4.4730	4.7228	4.9727	5.2226	5.4725	5.7224	5.9723
		Max....	3.2245	3.3494	3.4744	3.5993	3.7242	3.8492	3.9741	4.2240	4.4739	4.7237	4.9736	5.2235	5.4734	5.7233	5.9732
	Class 3..	Min....	3.2262	3.3511	3.4761	3.6010	3.7260	3.8509	3.9759	4.2255	4.4754	4.7253	4.9752	5.2252	5.4751	5.7250	5.9749
		Max....	3.2268	3.3517	3.4767	3.6016	3.7266	3.8515	3.9765	4.2264	4.4763	4.7262	4.9761	5.2261	5.4760	5.7259	5.9758
Pitch diameter of setting plug or ring gages for production and inspection.	Class 2..	Min....	3.1884	3.3133	3.4383	3.5632	3.6881	3.8131	3.9380	4.1879	4.4378	4.6876	4.9375	5.1874	5.4373	5.6872	5.9371
		Max....	3.1888	3.3137	3.4387	3.5636	3.6885	3.8135	3.9384	4.1885	4.4384	4.6882	4.9381	5.1880	5.4379	5.6878	5.9377
	Class 3..	Min....	3.1907	3.3156	3.4406	3.5655	3.6905	3.8154	3.9404	4.1903	4.4402	4.6901	4.9400	5.1900	5.4399	5.6898	5.9397
		Max....	3.1911	3.3160	3.4410	3.5659	3.6909	3.8158	3.9408	4.1909	4.4408	4.6907	4.9406	5.1906	5.4405	5.6904	5.9404
(OPTIONAL)																	
Pitch diameter of setting plug or ring gages for inspection (see par. 6, p. 31).	Class 2..	Min....	3.1880	3.3129	3.4379	3.5628	3.6877	3.8127	3.9376	4.1873	4.4372	4.6870	4.9369	5.1868	5.4367	5.6866	5.9365
		Max....	3.1884	3.3133	3.4383	3.5632	3.6881	3.8131	3.9380	4.1879	4.4378	4.6876	4.9375	5.1874	5.4373	5.6872	5.9371
	Class 3..	Min....	3.1903	3.3152	3.4402	3.5651	3.6901	3.8150	3.9400	4.1897	4.4396	4.6895	4.9394	5.1894	5.4393	5.6892	5.9391
		Max....	3.1907	3.3156	3.4406	3.5655	3.6905	3.8154	3.9404	4.1903	4.4402	4.6901	4.9400	5.1900	5.4399	5.6898	5.9397
Minor diameter of ring gage.....	Class 2..	Min....	3.1704	3.2953	3.4203	3.5452	3.6701	3.7951	3.9200	4.1699	4.1198	4.6696	4.9195	5.1694	5.4193	5.6692	5.9191
		Max....	3.1710	3.2959	3.4209	3.5458	3.6707	3.7957	3.9206	4.1708	4.4207	4.6705	4.9204	5.1703	5.4202	5.6701	5.9200
	Class 3..	Min....	3.1727	3.2976	3.4226	3.5475	3.6725	3.7974	3.9224	4.1723	4.4222	4.6721	4.9220	5.1720	5.4219	5.6718	5.9217
		Max....	3.1733	3.2982	3.4232	3.5481	3.6731	3.7980	3.9230	4.1732	4.4231	4.6730	4.9229	5.1729	5.4228	5.6727	5.9226

TABLE 44.—*Limiting dimensions of thread plug gages for nuts of classes 2 and 3 fits, American National 12-pitch thread series*

Limiting dimensions			Size (inches)													
			1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1	1 1/16	1 1/8	1 3/16	1 1/4	1 5/16	1 3/8
"GO" GAGES FOR NUTS																	
			Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage.....	Classes 2 and 3.	Min....	0.5000	0.5625	0.6250	0.6875	0.7500	0.8125	0.8750	0.9375	1.0000	1.0625	1.1250	1.1875	1.2500	1.3125	1.3750
		Max....	.5006	.5631	.6256	.6881	.7506	.8131	.8756	.9381	1.0006	1.0631	1.1256	1.1881	1.2506	1.3131	1.3756
Pitch diameter of plug gage.....	Classes 2 and 3.	Min Y..	.4461	.5086	.5711	.6336	.6961	.7586	.8211	.8836	.9461	1.0086	1.0711	1.1336	1.1961	1.2586	1.3211
		Max Y..	.4465	.5090	.5715	.6340	.6965	.7590	.8215	.8840	.9465	1.0090	1.0715	1.1340	1.1965	1.2590	1.3215
		Min X..	.4459	.5084	.5709	.6334	.6959	.7584	.8209	.8834	.9459	1.0084	1.0709	1.1334	1.1959	1.2584	1.3209
		Max X..	.4462	.5087	.5712	.6337	.6962	.7587	.8212	.8837	.9462	1.0087	1.0712	1.1337	1.1962	1.2587	1.3212
"NOT GO" GAGES FOR NUTS																	
Major diameter of plug gage.....	Class 2...	Max....	.4876	.5501	.6126	.6751	.7376	.8001	.8626	.9251	.9876	1.0501	1.1126	1.1751	1.2376	1.3001	1.3626
		Min....	.4870	.5495	.6120	.6745	.7370	.7995	.8620	.9245	.9870	1.0495	1.1120	1.1745	1.2370	1.2995	1.3620
	Class 3...	Max....	.4860	.5485	.6110	.6735	.7360	.7985	.8610	.9235	.9860	1.0485	1.1110	1.1735	1.2360	1.2985	1.3610
		Min....	.4854	.5479	.6104	.6729	.7354	.7979	.8604	.9229	.9854	1.0479	1.1104	1.1729	1.2354	1.2979	1.3604
Pitch diameter of thread plug gages for production and inspection.	Class 2...	Max....	.4515	.5140	.5765	.6390	.7015	.7640	.8265	.8890	.9515	1.0140	1.0765	1.1390	1.2015	1.2640	1.3265
		Min....	.4512	.5137	.5762	.6387	.7012	.7637	.8262	.8887	.9512	1.0137	1.0762	1.1387	1.2012	1.2637	1.3262
	Class 3...	Max....	.4499	.5124	.5749	.6374	.6999	.7624	.8249	.8874	.9499	1.0124	1.0749	1.1374	1.1999	1.2624	1.3249
		Min....	.4496	.5121	.5746	.6371	.6996	.7621	.8246	.8871	.9496	1.0121	1.0746	1.1371	1.1996	1.2621	1.3246
(OPTIONAL)																	
Pitch diameter of thread plug gages for inspection (see par. 6, p. 31).	Class 2...	Max....	.4518	.5143	.5768	.6393	.7018	.7643	.8268	.8893	.9518	1.0143	1.0768	1.1393	1.2018	1.2643	1.3268
		Min....	.4515	.5140	.5765	.6390	.7015	.7640	.8265	.8890	.9515	1.0140	1.0765	1.1390	1.2015	1.2640	1.3265
	Class 3...	Max....	.4502	.5127	.5752	.6377	.7002	.7627	.8252	.8877	.9502	1.0127	1.0752	1.1377	1.2002	1.2627	1.3252
		Min....	.4499	.5124	.5749	.6374	.6999	.7624	.8249	.8874	.9499	1.0124	1.0749	1.1374	1.1999	1.2624	1.3249

Limiting dimensions			Size (inches)													
			1 7/16	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3	3 1/8
"GO" GAGES FOR NUTS																	
			Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage.....	Classes 2 and 3.	Min....	1.4375	1.5000	1.6250	1.7500	1.8750	2.0000	2.1250	2.2500	2.3750	2.5000	2.6250	2.7500	2.8750	3.0000	3.1250
		Max....	1.4381	1.5006	1.6256	1.7506	1.8756	2.0006	2.1256	2.2506	2.3756	2.5006	2.6256	2.7506	2.8756	3.0006	3.1256
Pitch diameter of plug gage.....	Classes 2 and 3.	Min Y..	1.3836	1.4461	1.5711	1.6961	1.8211	1.9461	2.0711	2.1961	2.3211	2.4461	2.5711	2.6961	2.8211	2.9461	3.0711
		Max Y..	1.3840	1.4465	1.5717	1.6967	1.8217	1.9467	2.0717	2.1967	2.3217	2.4467	2.5717	2.6967	2.8217	2.9467	3.0717
		Min X..	1.3834	1.4459	1.5709	1.6959	1.8209	1.9459	2.0709	2.1959	2.3209	2.4459	2.5709	2.6959	2.8209	2.9459	3.0709
		Max X..	1.3837	1.4462	1.5713	1.6963	1.8213	1.9463	2.0713	2.1963	2.3213	2.4463	2.5713	2.6963	2.8213	2.9463	3.0713

TABLE 44.—*Limiting dimensions of thread plug gages for nuts of classes 2 and 3 fits, American National 12-pitch thread series*—Continued

Limiting dimensions			Size (inches)														
			1 7/16	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3	3 1/8
"NOT GO" GAGES FOR NUTS			*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage	Class 2	Max.	1.4251	1.4876	1.6134	1.7385	1.8636	1.9887	2.1138	2.2389	2.3640	2.4891	2.6141	2.7392	2.8643	2.9894	3.1144
		Min.	1.4245	1.4870	1.6128	1.7379	1.8630	1.9881	2.1132	2.2383	2.3634	2.4885	2.6135	2.7386	2.8637	2.9888	3.1138
	Class 3	Max.	1.4235	1.4860	1.6115	1.7366	1.8616	1.9867	2.1118	2.2368	2.3619	2.4869	2.6120	2.7370	2.8621	2.9871	3.1122
		Min.	1.4229	1.4854	1.6109	1.7360	1.8610	1.9861	2.1112	2.2362	2.3613	2.4863	2.6114	2.7364	2.8615	2.9865	3.1116
Pitch diameter of thread plug gages for production and inspection.	Class 2	Max.	1.3890	1.4515	1.5773	1.7024	1.8275	1.9526	2.0777	2.2028	2.3279	2.4530	2.5780	2.7031	2.8282	2.9533	3.0783
		Min.	1.3887	1.4512	1.5769	1.7020	1.8271	1.9522	2.0773	2.2024	2.3275	2.4526	2.5776	2.7027	2.8278	2.9529	3.0779
	Class 3	Max.	1.3874	1.4499	1.5754	1.7005	1.8255	1.9506	2.0757	2.2007	2.3258	2.4508	2.5759	2.7009	2.8260	2.9510	3.0761
		Min.	1.3871	1.4496	1.5750	1.7001	1.8251	1.9502	2.0753	2.2003	2.3254	2.4504	2.5755	2.7005	2.8256	2.9506	3.0757
(OPTIONAL)																	
Pitch diameter of thread plug gages for inspection (see par. 6, p.31).	Class 2	Max.	1.3893	1.4518	1.5777	1.7028	1.8279	1.9530	2.0781	2.2032	2.3283	2.4534	2.5784	2.7035	2.8286	2.9537	3.0787
		Min.	1.3890	1.4515	1.5773	1.7024	1.8275	1.9526	2.0777	2.2028	2.3279	2.4530	2.5780	2.7031	2.8282	2.9533	3.0783
	Class 3	Max.	1.3877	1.4502	1.5758	1.7009	1.8259	1.9510	3.0761	2.2011	2.3262	2.4512	2.5763	2.7013	2.8264	2.9514	3.0765
		Min.	1.3874	1.4499	1.5754	1.7005	1.8255	1.9506	2.0757	2.2007	2.3258	2.4508	2.5759	2.7009	2.8260	2.9510	3.0761

Limiting dimensions			Size (inches)														
			3 1/4	3 3/8	3 1/2	3 5/8	3 3/4	3 7/8	4	4 1/4	4 1/2	4 3/4	5	5 1/4	5 1/2	5 3/4	6
"GO" GAGES FOR NUTS			*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage	Classes 2 and 3.	Min.	3.2500	3.3750	3.5000	3.6250	3.7500	3.8750	4.0000	4.2500	4.5000	4.7500	5.0000	5.2500	5.5000	5.7500	6.0000
		Max.	3.2506	3.3756	3.5006	3.6256	3.7506	3.8756	4.0006	4.2509	4.5009	4.7509	5.0009	5.2509	5.5009	5.7509	6.0009
Pitch diameter of plug gage	Classes 2 and 3.	Min Y.	3.1951	3.3211	3.4461	3.5711	3.6961	3.8211	3.9461	4.1961	4.4461	4.6961	4.9461	5.1961	5.4461	5.6961	5.9461
		Max Y.	3.1967	3.3217	3.4467	3.5717	3.6967	3.8217	3.9467	4.1969	4.4469	4.6969	4.9469	5.1969	5.4469	5.6969	5.9469
		Min X.	3.1959	3.3209	3.4459	3.5709	3.6959	3.8209	3.9459	4.1959	4.4459	4.6959	4.9459	5.1959	5.4459	5.6959	5.9459
		Max X.	3.1963	3.3213	3.4463	3.5713	3.6963	3.8213	3.9463	4.1965	4.4465	4.6965	4.9465	5.1965	5.4465	5.6965	5.9465
"NOT GO" GAGES FOR NUTS																	
Major diameter of plug gage	Class 2	Max.	3.2395	3.3646	3.4896	3.6147	3.7398	3.8648	3.9899	4.2400	4.4901	4.7403	4.9904	5.2405	5.4906	5.7407	5.9908
		Min.	3.2389	3.3640	3.4890	3.6141	3.7392	3.8642	3.9893	4.2391	4.4892	4.7394	4.9895	5.2396	5.4897	5.7398	5.9899
	Class 3	Max.	3.2372	3.3623	3.4873	3.6124	3.7374	3.8625	3.9875	4.2376	4.4877	4.7378	4.9879	5.2379	5.4880	5.7381	5.9882
		Min.	3.2366	3.3617	3.4867	3.6118	3.7368	3.8619	3.9869	4.2367	4.4868	4.7369	4.9870	5.2370	5.4871	5.7372	5.9873
Pitch diameter of thread plug gages for production and inspection.	Class 2	Max.	3.2034	3.3285	3.4535	3.5786	3.7037	3.8287	3.9538	4.2039	4.4540	4.7042	4.9543	5.2044	5.4545	5.7046	5.9547
		Min.	3.2030	3.3281	3.4531	3.5782	3.7033	3.8283	3.9534	4.2033	4.4534	4.7036	4.9537	5.2038	5.4539	5.7040	5.9541
	Class 3	Max.	3.2011	3.3262	3.4512	3.5763	3.7013	3.8264	3.9514	4.2015	4.4516	4.7017	4.9518	5.2018	5.4519	5.7020	5.9521
		Min.	3.2007	3.3258	3.4508	3.5759	3.7009	3.8260	3.9510	4.2009	4.4510	4.7011	4.9512	5.2012	5.4513	5.7014	5.9515
(OPTIONAL)																	
Pitch diameter of thread plug gages for inspection (see par. 6, p.31).	Class 2	Max.	3.2038	3.3289	3.4539	3.5790	3.7041	3.8291	3.9542	4.2045	4.4546	4.7048	4.9549	5.2050	5.4551	5.7052	5.9553
		Min.	3.2034	3.3285	3.4535	3.5786	3.7037	3.8287	3.9538	4.2039	4.4540	4.7042	4.9543	5.2044	5.4545	5.7046	5.9547
	Class 3	Max.	3.2015	3.3266	3.4516	3.5767	3.7017	3.8268	3.9518	4.2021	4.4522	4.7023	4.9524	5.2024	5.4525	5.7026	5.9527
		Min.	3.2011	3.3262	3.4512	3.5763	3.7013	3.8264	3.9514	4.2015	4.4516	4.7017	4.9518	5.2018	5.4519	5.7020	5.9521

TABLE 45.—*Limiting dimensions of Y plain gages for screws and nuts of classes 2 and 3 fits, American National 12-pitch thread series*

Size	Gages for major diameter of screw				Gages for minor diameter of nut			
	"Go" gage		"Not go" gage		"Go" gage		"Not go" gage	
	Maximum	Minimum	Minimum	Maximum	Minimum	Maximum	Maximum	Minimum
1	2	3	4	5	6	7	8	9
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1/2	0.50000	0.49993	0.48880	0.48887	0.40980	0.40987	0.42250	0.42243
9/16	.56250	.56243	.55130	.55137	.47230	.47237	.48500	.48493
5/8	.62500	.62493	.61380	.61387	.53480	.53487	.54380	.54373
11/16	.68750	.68743	.67630	.67637	.59730	.59737	.60630	.60623
3/4	.75000	.74993	.73880	.73887	.65980	.65987	.66880	.66873
13/16	.81250	.81243	.80130	.80137	.72230	.72237	.73130	.73123
7/8	.87500	.87491	.86380	.86389	.78480	.78487	.79380	.79373
15/16	.93750	.93741	.92630	.92639	.84730	.84739	.85630	.85621
1	1.00000	.99991	.98880	.98889	.90980	.90989	.91880	.91871
1 1/16	1.06250	1.06241	1.05130	1.05139	.97230	.97239	.98130	.98121
1 1/8	1.12500	1.12491	1.11380	1.11389	1.03480	1.03489	1.04380	1.04371
1 3/16	1.18750	1.18741	1.17630	1.17639	1.09730	1.09739	1.10630	1.10621
1 1/4	1.25000	1.24991	1.23880	1.23889	1.15980	1.15989	1.16880	1.16871
1 5/16	1.31250	1.31241	1.30130	1.30139	1.22230	1.22239	1.23130	1.23121
1 3/8	1.37500	1.37491	1.36380	1.36389	1.28480	1.28489	1.29380	1.29371
1 7/16	1.43750	1.43741	1.42630	1.42639	1.34730	1.34739	1.35630	1.35621
1 1/2	1.50000	1.49991	1.48880	1.48889	1.40980	1.40989	1.41880	1.41871
1 5/8	1.62500	1.62488	1.61380	1.61392	1.53480	1.53492	1.54380	1.54368
1 3/4	1.75000	1.74988	1.73880	1.73892	1.65980	1.65992	1.66880	1.66868
1 7/8	1.87500	1.87488	1.86380	1.86392	1.78480	1.78492	1.79380	1.79368
2	2.00000	1.99988	1.98880	1.98892	1.90980	1.90992	1.91880	1.91868
2 1/8	2.12500	2.12488	2.11380	2.11392	2.03480	2.03492	2.04380	2.04368
2 1/4	2.25000	2.24988	2.23880	2.23892	2.15980	2.15992	2.16880	2.16868
2 3/8	2.37500	2.37488	2.36380	2.36392	2.28480	2.28492	2.29380	2.29368
2 1/2	2.50000	2.49988	2.48880	2.48892	2.40980	2.40992	2.41880	2.41868
2 5/8	2.62500	2.62485	2.61380	2.61395	2.53480	2.53495	2.54380	2.54365
2 3/4	2.75000	2.74985	2.73880	2.73895	2.65980	2.65995	2.66880	2.66865
2 7/8	2.87500	2.87485	2.86380	2.86395	2.78480	2.78495	2.79380	2.79365
3	3.00000	2.99985	2.98880	2.98895	2.90980	2.90995	2.91880	2.91865
3 1/8	3.12500	3.12485	3.11380	3.11395	3.03480	3.03495	3.04380	3.04365
3 1/4	3.25000	3.24985	3.23880	3.23895	3.15980	3.15995	3.16880	3.16865
3 3/8	3.37500	3.37485	3.36380	3.36395	3.28480	3.28495	3.29380	3.29365
3 1/2	3.50000	3.49985	3.48880	3.48895	3.40980	3.40995	3.41880	3.41865
3 5/8	3.62500	3.62485	3.61380	3.61395	3.53480	3.53495	3.54380	3.54365
3 3/4	3.75000	3.74985	3.73880	3.73895	3.65980	3.65995	3.66880	3.66865
3 7/8	3.87500	3.87485	3.86380	3.86395	3.78480	3.78495	3.79380	3.79365
4	4.00000	3.99985	3.98880	3.98895	3.90980	3.90995	3.91880	3.91865
4 1/4	4.25000	4.24985	4.23880	4.23895	4.15980	4.15995	4.16880	4.16865
4 1/2	4.50000	4.49985	4.48880	4.48895	4.40980	4.40995	4.41880	4.41865
4 3/4	4.75000	4.74980	4.73880	4.73899	4.65980	4.65999	4.66880	4.66861
5	5.00000	4.99981	4.98880	4.98899	4.90980	4.90999	4.91880	4.91861
5 1/4	5.25000	5.24981	5.23880	5.23899	5.15980	5.15999	5.16880	5.16861
5 1/2	5.50000	5.49981	5.48880	5.48899	5.40980	5.40999	5.41880	5.41861
5 3/4	5.75000	5.74981	5.73880	5.73899	5.65980	5.65999	5.66880	5.66861
6	6.00000	5.99981	5.98880	5.98899	5.90980	5.90999	5.91880	5.91861

TABLE 46.—*Sizes of tap drills, American National 12-pitch thread series*

Size of thread	Threads per inch	Minor diameter of nut			Stock drills and corresponding percentage of basic thread depth[1]		
		Basic	Maximum	Minimum	Nominal size	Diameter	Percentage of depth of basic thread
		Inches	*Inches*	*Inches*		*Inches*	
½	12	0.3917	0.4225	0.4098	Z[2]	0.4130	80
					10.5 mm[2]	.4134	80
					27/64 in.	.4219	72
9/16	12	.4542	.4850	.4723	12 mm[2]	.4724	83
					31/64 in.	.4844	72
5/8	12	.5167	.5438	.5348	*13.5 mm.*	.5315	86
					35/64 in.	.5469	72
11/16	12	.5792	.6063	.5973	*19/32 in.*	.5938	87
					39/64 in.	.6094	72
¾	12	.6417	.6688	.6598	*21/32 in.*	.6562	87
					17 mm.	.6693	75
13/16	12	.7042	.7313	.7223	18.5 mm.	.7283	78
⅞	12	.7667	.7938	.7848	20 mm.	.7874	81
15/16	12	.8292	.8563	.8473	*21.5 mm.*	.8465	84
					55/64 in.	.8594	72
1	12	.8917	.9188	.9098	*29/32 in.*	.9062	87
					59/64 in.	.9219	72
1 1/16	12	.9542	.9813	.9723	*31/32 in.*	.9687	87
					25 mm.	.9843	72
1 1/8	12	1.0167	1.0438	1.0348	26.5 mm.	1.0433	75
1 3/16	12	1.0792	1.1063	1.0973	28 mm.	1.1024	79
1 ¼	12	1.1417	1.1688	1.1598	29.5 mm.	1.1614	82
1 5/16	12	1.2042	1.2313	1.2223	*31 mm.*	1.2205	85
					1 15/64 in.	1.2344	72
1 3/8	12	1.2667	1.2938	1.2848	*1 9/32 in.*	1.2812	87
					1 19/64 in.	1.2969	72
1 7/16	12	1.3292	1.3563	1.3473	*1 11/32 in.*	1.3438	87
					34.5 mm.	1.3583	73
1 ½	12	1.3917	1.4188	1.4098	36 mm.	1.4173	76
1 5/8	12	1.5167	1.5438	1.5348	39 mm.	1.5354	83
1 ¾	12	1.6417	1.6688	1.6598	*1 21/32 in.*	1.6562	87
					1 43/64 in.	1.6719	72
1 7/8	12	1.7667	1.7938	1.7848	45.5 mm.	1.7913	77
2	12	1.8917	1.9188	1.9098	*48.5 mm.*	1.9094	84
					1 59/64 in.	1.9219	72
2 1/8	12	2.0167	2.0438	2.0348	*2 1/32 in.*	2.0312	87
					2 3/64 in.	2.0469	72
2 ¼	12	2.1417	2.1688	2.1598	55 mm.	2.1654	78
2 3/8	12	2.2667	2.2938	2.2848	*58 mm.*	2.2835	85
					2 19/64 in.	2.2969	72
2 ½	12	2.3917	2.4188	2.4098	*2 13/32 in.*	2.4062	87
					61.5 mm.	2.4213	73
2 5/8	12	2.5167	2.5438	2.5348	64.5 mm.	2.5394	79
2 ¾	12	2.6417	2.6688	2.6598	*67.5 mm.*	2.6575	85
					2 43/64 in.	2.6719	72
2 7/8	12	2.7667	2.7938	2.7848	*2 25/32 in.*	2.7812	87
					71 mm.	2.7953	74
3	12	2.8917	2.9188	2.9098	74 mm.	2.9134	80
3 1/8	12	3.0167	3.0438	3.0348	*3 1/32 in.*	3.0312	87
					3 1/16 in.	3.0625	58
3 ¼	12	3.1417	3.1688	3.1598	*3 5/32 in.*	3.1562	87
					3 3/16 in.	3.1875	58
3 3/8	12	3.2667	3.2938	3.2848	*3 9/32 in.*	3.2812	87
					3 5/16 in.	3.3125	58
3 ½	12	3.3917	3.4188	3.4098	*3 7/16 in.*	3.4375	58

[1] Sizes in italic type are not within the specified limits for minor diameter of nut. See p. 43.

[2] These sizes are not included as standard in ASA B5.12-1940, Twist Drills, Straight Shank, but are listed in the appendix thereto.

7. AMERICAN NATIONAL 16-PITCH THREAD SERIES

The nominal sizes and basic dimensions of the "American National 16-pitch thread series" are specified in table 15, p. 45.

The 16-pitch series is a uniform pitch series for such applications as require a relatively fine thread. It is intended primarily for use on threaded adjusting collars and bearing retaining nuts.

Threads of the American National 16-pitch thread series are designated by the symbol "16N." Example:

Threaded part 1 inch diameter, 16 threads per inch, class 3 fit, mark.....1"-16N-3

Limiting dimensions for the American National 16-pitch thread series, classes 2 and 3, are given in table 47, the limiting dimensions of thread gages in tables 48, 49, and 50, and tap drill sizes in table 51.

TABLE 47.— *Limiting dimensions and tolerances, classes 2 and 3 fit, American National 16-pitch-thread series*

Dimensions and tolerances[1]		Size (inches)									
		3/4[2]	13/16	7/8	15/16	1	1 1/16	1 1/8	1 3/16	1 1/4	1 5/16
BOLTS AND SCREWS		*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter	Max...	0.7500	0.8125	0.8750	0.9375	1.0000	1.0625	1.1250	1.1875	1.2500	1.3125
	Min...	.7410	.8035	.8660	.9285	0.9910	1.0535	1.1160	1.1785	1.2410	1.3035
	Tol...	.0090	.0090	.0090	.0090	.0090	0.0090	0.0090	0.0090	0.0090	0.0090
Minor diameter	Max[3]..	.6733	.7358	.7983	.8608	.9233	.9858	1.0483	1.1108	1.1733	1.2358
Class 2, pitch diameter (for general use).	Max[5]..	.7094	.7719	.8344	.8969	.9594	1.0219	1.0844	1.1469	1.2094	1.2719
	Min...	.7049	.7668	.8293	.8917	.9542	1.0166	1.0790	1.1415	1.2039	1.2664
	Tol...	.0045	.0051	.0051	.0052	.0052	0.0053	0.0054	0.0054	0.0055	0.0055
Class 3, pitch diameter	Max[5]..	.7094	.7719	.8344	.8969	.9594	1.0219	1.0844	1.1469	1.2094	1.2719
	Min...	.7062	.7684	.8308	.8933	.9557	1.0182	1.0806	1.1431	1.2056	1.2680
	Tol...	.0032	.0035	.0036	.0036	.0037	0.0037	0.0038	0.0038	0.0038	0.0039
NUTS AND TAPPED HOLES											
Major diameter	Min[4]..	.7500	.8125	.8750	.9375	1.0000	1.0625	1.1250	1.1875	1.2500	1.3125
Minor diameter	Min...	.6823	.7448	.8073	.8698	0.9323	0.9948	1.0573	1.1198	1.1823	1.2448
	Max...	.6903	.7528	.8153	.8778	.9403	1.0028	1.0653	1.1278	1.1903	1.2528
	Tol...	.0080	.0080	.0080	.0080	.0080	0.0080	0.0080	0.0080	0.0080	0.0080
Class 2, pitch diameter (for general use).	Min[5]..	.7094	.7719	.8344	.8969	.9594	1.0219	1.0844	1.1469	1.2094	1.2719
	Max...	.7139	.7770	.8395	.9021	.9646	1.0272	1.0898	1.1523	1.2149	1.2774
	Tol...	.0045	.0051	.0051	.0052	.0052	0.0053	0.0054	0.0054	0.0055	0.0055
Class 3, pitch diameter	Min[5]..	.7094	.7719	.8344	.8969	.9594	1.0219	1.0844	1.1469	1.2094	1.2719
	Max...	.7126	.7754	.8380	.9005	.9631	1.0256	1.0882	1.1507	1.2132	1.2758
	Tol...	.0032	.0035	.0036	.0036	.0037	0.0037	0.0038	0.0038	0.0038	0.0039

See footnotes at end of table.

TABLE 47.—*Limiting dimensions and tolerances, classes 2 and 3 fit, American National 16-pitch-thread series*—Continued

Dimensions and tolerances[1]		Size (inches)									
		1⅜	1⁷⁄₁₆	1½	1⁹⁄₁₆	1⅝	1¹¹⁄₁₆	1¾	1¹³⁄₁₆	1⅞	1¹⁵⁄₁₆
BOLTS AND SCREWS		*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter	Max...	1.3750	1.4375	1.5000	1.5625	1.6250	1.6875	1.7500	1.8125	1.8750	1.9375
	Min...	1.3660	1.4285	1.4910	1.5535	1.6160	1.6785	1.7410	1.8035	1.8660	1.9285
	Tol...	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090
Minor diameter	Max[3]..	1.2983	1.3608	1.4233	1.1858	1.5483	1.6108	1.6733	1.7358	1.7983	1.8608
Class 2, pitch diameter (for general use.)	Max[5]..	1.3344	1.3969	1.4594	1.5219	1.5844	1.6469	1.7094	1.7719	1.8344	1.8969
	Min...	1.3288	1.3913	1.4537	1.5161	1.5786	1.6411	1.7035	1.7660	1.8284	1.8909
	Tol...	0.0056	0.0056	0.0057	0.0058	0.0058	0.0058	0.0059	0.0059	0.0060	0.0060
Class 3, pitch diameter	Max[5]..	1.3344	1.3969	1.4594	1.5219	1.5844	1.6469	1.7094	1.7719	1.8344	1.8969
	Min...	1.3305	1.3929	1.4554	1.5179	1.5803	1.6428	1.7053	1.7677	1.8302	1.8927
	Tol...	0.0039	0.0040	0.0040	0.0040	0.0041	0.0041	0.0041	0.0042	0.0042	0.0042
NUTS AND TAPPED HOLES											
Major diameter	Min[4]..	1.3750	1.4375	1.5000	1.5625	1.6250	1.6875	1.7500	1.8125	1.8750	1.9375
Minor diameter	Min...	1.3073	1.3698	1.4323	1.4948	1.5573	1.6198	1.6823	1.7448	1.8073	1.8698
	Max...	1.3153	1.3778	1.4403	1.5028	1.5653	1.6278	1.6903	1.7528	1.8153	1.8778
	Tol...	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080
Class 2, pitch diameter (for general use).	Min[5]..	1.3344	1.3969	1.4594	1.5219	1.5844	1.6469	1.7094	1.7719	1.8344	1.8969
	Max...	1.3400	1.4025	1.4651	1.5277	1.5902	1.6527	1.7153	1.7778	1.8404	1.9029
	Tol...	0.0056	0.0056	0.0057	0.0058	0.0058	0.0058	0.0059	0.0059	0.0060	0.0060
Class 3, pitch diameter	Min[5]..	1.3344	1.3969	1.4594	1.5219	1.5844	1.6469	1.7094	1.7719	1.8344	1.8969
	Max...	1.3383	1.4009	1.4634	1.5259	1.5885	1.6510	1.7135	1.7761	1.8386	1.9011
	Tol...	0.0039	0.0040	0.0040	0.0040	0.0041	0.0041	0.0041	0.0042	0.0042	0.0042

Dimensions and tolerances[1]		Size (inches)									
		2	2¹⁄₁₆	2⅛	2³⁄₁₆	2¼	2⁵⁄₁₆	2⅜	2⁷⁄₁₆	2½	2⅝
BOLTS AND SCREWS		*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter	Max...	2.0000	2.0625	2.1250	2.1875	2.2500	2.3125	2.3750	2.4375	2.5000	2.6250
	Min...	1.9910	2.0535	2.1160	2.1785	2.2410	2.3035	2.3660	2.4285	2.4910	2.6160
	Tol...	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090
Minor diameter	Max[3]..	1.9233	1.9858	2.0483	2.1108	2.1733	2.2358	2.2983	2.3608	2.4233	2.5483
Class 2, pitch diameter (for general use).	Max[5]..	1.9594	2.0219	2.0844	2.1469	2.2094	2.2719	2.3344	2.3969	2.4594	2.5844
	Min...	1.9533	2.0158	2.0782	2.1407	2.2032	2.2656	2.3281	2.3905	2.4530	2.5779
	Tol...	0.0061	0.0061	0.0062	0.0062	0.0062	0.0063	0.0063	0.0064	0.0064	0.0065
Class 3, pitch diameter	Max[5]..	1.9594	2.0219	2.0844	2.1469	2.2094	2.2719	2.3344	2.3969	2.4594	2.5844
	Min...	1.9551	2.0176	2.0801	2.1426	2.2050	2.2675	2.3300	2.3924	2.4549	2.5799
	Tol...	0.0043	0.0043	0.0043	0.0043	0.0044	0.0044	0.0044	0.0045	0.0045	0.0045
NUTS AND TAPPED HOLES											
Major diameter	Min[4]..	2.0000	2.0625	2.1250	2.1875	2.2500	2.3125	2.3750	2.4375	2.5000	2.6250
Minor diameter	Min...	1.9323	1.9948	2.0573	2.1198	2.1823	2.2448	2.3073	2.3698	2.4323	2.5573
	Max...	1.9403	2.0028	2.0653	2.1278	2.1903	2.2528	2.3153	2.3778	2.4403	2.5653
	Tol...	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080
Class 2, pitch diameter (for general use).	Min[5]..	1.9594	2.0219	2.0844	2.1469	2.2094	2.2719	2.3344	2.3969	2.4594	2.5844
	Max...	1.9655	2.0280	2.0906	2.1531	2.2156	2.2782	2.3407	2.4033	2.4658	2.5909
	Tol...	0.0061	0.0061	0.0062	0.0062	0.0062	0.0063	0.0063	0.0064	0.0064	0.0065
Class 3, pitch diameter	Min[5]..	1.9594	2.0219	2.0844	2.1469	2.2094	2.2719	2.3344	2.3969	2.4594	2.5844
	Max...	1.9637	2.0262	2.0887	2.1512	2.2138	2.2763	2.3388	2.4014	2.4639	2.5889
	Tol...	0.0043	0.0043	0.0043	0.0043	0.0044	0.0044	0.0044	0.0045	0.0045	0.0045

See footnotes at end of table.

TABLE 47.—*Limiting dimensions and tolerances, classes 2 and 3 fit, American National 16-pitch-thread series*—Continued

Dimensions and tolerances[1]	Size (inches)										
	2¾	2⅞	3	3⅛	3¼	3⅜	3½	3⅝	3¾	3⅞	4
BOLTS AND SCREWS											
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter..... Max...	2.7500	2.8750	3.0000	3.1250	3.2500	3.3750	3.5000	3.6250	3.7500	3.8750	4.0000
Major diameter..... Min...	2.7410	2.8660	2.9910	3.1160	3.2410	3.3660	3.4910	3.6160	3.7410	3.8660	3.9910
Major diameter..... Tol...	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090	0.0090
Minor diameter..... Max[3]..	2.6733	2.7983	2.9233	3.0483	3.1733	3.2983	3.4233	3.5483	3.6733	3.7983	3.9233
Class 2, pitch diameter (for general use). Max[5]..	2.7094	2.8344	2.9594	3.0844	3.2094	3.3344	3.4594	3.5844	3.7094	3.8341	3.9594
Class 2, pitch diameter (for general use). Min...	2.7028	2.8278	2.9527	3.0776	3.2025	3.3275	3.4524	3.5773	3.7023	3.8272	3.9522
Class 2, pitch diameter (for general use). Tol...	0.0066	0.0066	0.0067	0.0068	0.0069	0.0069	0.0070	0.0071	0.0071	0.0072	0.0072
Class 3, pitch diameter..... Max[5]..	2.7094	2.8344	2.9594	3.0844	3.2094	3.3344	3.4594	3.5844	3.7094	3.8344	3.9594
Class 3, pitch diameter..... Min...	2.7048	2.8298	2.9547	3.0797	3.2046	3.3296	3.4545	3.5795	3.7044	3.8294	3.9543
Class 3, pitch diameter..... Tol...	0.0046	0.0046	0.0047	0.0047	0.0048	0.0048	0.0049	0.0049	0.0050	0.0050	0.0051
NUTS AND TAPPED HOLES											
Major diameter..... Min[4]..	2.7500	2.8750	3.0000	3.1250	3.2500	3.3750	3.5000	3.6250	3.7500	3.8750	4.0000
Minor diameter..... Min...	2.6823	2.8073	2.9323	3.0573	3.1823	3.3073	3.4323	3.5573	3.6823	3.8073	3.9323
Minor diameter..... Max...	2.6903	2.8153	2.9403	3.0653	3.1903	3.3153	3.4403	3.5653	3.6903	3.8153	3.9403
Minor diameter..... Tol...	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080
Class 2, pitch diameter (for general use). Min[5]..	2.7094	2.8344	2.9591	3.0844	3.2094	3.3344	3.4594	3.5844	3.7094	3.8344	3.9594
Class 2, pitch diameter (for general use). Max...	2.7100	2.8410	2.9661	3.0912	3.2163	3.3413	3.4664	3.5915	3.7165	3.8416	3.9666
Class 2, pitch diameter (for general use). Tol...	0.0066	0.0066	0.0067	0.0068	0.0069	0.0069	0.0070	0.0071	0.0071	0.0072	0.0072
Class 3, pitch diameter..... Min[5]..	2.7094	2.8344	2.9594	3.0844	3.2094	3.3344	3.4594	3.5841	3.7094	3.8344	3.9594
Class 3, pitch diameter..... Max...	2.7140	2.8390	2.9641	3.0891	3.2142	3.3392	3.4643	3.5893	3.7144	3.8394	3.9645
Class 3, pitch diameter..... Tol...	0.0046	0.0046	0.0047	0.0047	0.0048	0.0048	0.0049	0.0049	0.0050	0.0050	0.0051

[1]Pitch-diameter tolerances include errors of lead and angle. The class 2 tolerances are based on formulas in table 143 and a length of engagement of 6 threads or ⅜ inch. The class 3 tolerances are 70 percent of the class 2 tolerances. The ¾-inch size being in the American National fine-thread series, the tolerance for this size corresponds to that series.

[2]Standard size screw and nut of the American National fine-thread series.

[3]Dimensions given for the maximum minor diameter of the screw are figured to the intersection of the worn-tool arc with a center line through crest and root. The minimum minor diameter of the screw shall be that corresponding to a flat at the minor diameter of the minimum screw equal to $\frac{1}{8} \times p$, and may be determined by subtracting 0.0406 inch from the minimum pitch diameter of the screw.

[4]Dimensions for the minimum major diameter of the nut correspond to the basic flat ($\frac{1}{8} \times p$) and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the nut shall be that corresponding to a flat at the major diameter of the maximum nut equal to $\frac{1}{24} \times p$, and may be determined by adding 0.0496 inch to the maximum pitch diameter of the nut.

[5]These dimensions are the maximum metal or "go" size, and are those which should be placed on the component drawing with the tolerances.

TABLE 48.—*Limiting dimensions of setting plug and thread ring gages for screws of classes 2 and 3 fits, American National 16-pitch thread series*

Limiting dimensions	Size (inches)													
	3/4	13/16	7/8	15/16	1	1 1/16	1 1/8	1 3/16	1 1/4	1 5/16	1 3/8	1 7/16	1 1/2	1 9/16
"GO" GAGES FOR SCREWS														
	Inch	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of full-form setting plug, and full portion of truncated setting plug. — Classes 2 and 3. — Max....	0.7506	0.8131	0.8756	0.9381	1.0006	1.0631	1.1256	1.1881	1.2506	1.3131	1.3756	1.4381	1.5006	1.5631
Major diameter of full-form setting plug, and full portion of truncated setting plug. — Classes 2 and 3. — Min....	.7500	.8125	.8750	.9375	1.0000	1.0625	1.1250	1.1875	1.2500	1.3125	1.3750	1.4375	1.5000	1.5625
Major diameter of truncated portion of truncated setting plug. — Classes 2 and 3. — Max....	.7410	.8035	.8660	.9285	.9910	1.0535	1.1160	1.1785	1.2410	1.3035	1.3660	1.4285	1.4910	1.5535
Major diameter of truncated portion of truncated setting plug. — Classes 2 and 3. — Min....	.7404	.8029	.8654	.9279	.9904	1.0529	1.1154	1.1779	1.2404	1.3029	1.3654	1.4279	1.4904	1.5529
Pitch diameter of setting plug or ring gage. — Classes 2 and 3. — Max Y..	.7092	.7717	.8342	.8967	.9592	1.0217	1.0842	1.1467	1.2092	1.2717	1.3342	1.3967	1.4592	1.5217
Pitch diameter of setting plug or ring gage. — Classes 2 and 3. — Min Y..	.7088	.7713	.8338	.8963	.9588	1.0213	1.0838	1.1463	1.2088	1.2713	1.3338	1.3963	1.4588	1.5211
Pitch diameter of setting plug or ring gage. — Classes 2 and 3. — Max X..	.7094	.7719	.8344	.8969	.9594	1.0219	1.0844	1.1469	1.2094	1.2719	1.3344	1.3969	1.4594	1.5219
Pitch diameter of setting plug or ring gage. — Classes 2 and 3. — Min X..	.7091	.7716	.8341	.8966	.9591	1.0216	1.0841	1.1466	1.2091	1.2716	1.3341	1.3966	1.4591	1.5215
Minor diameter of ring gage..... — Classes 2 and 3. — Max....	.6823	.7448	.8073	.8698	.9323	0.9948	1.0573	1.1198	1.1823	1.2448	1.3073	1.3698	1.4323	1.4948
Minor diameter of ring gage..... — Classes 2 and 3. — Min....	.6817	.7442	.8067	.8692	.9317	.9942	1.0567	1.1192	1.1817	1.2442	1.3067	1.3692	1.4317	1.4942
"NOT GO" GAGES FOR SCREWS														
Major diameter of full-form setting plug, and full portion of truncated setting plug. — Classes 2 and 3. — Min....	.7500	.8125	.8750	.9375	1.0000	1.0625	1.1250	1.1875	1.2500	1.3125	1.3750	1.4375	1.5000	1.5625
Major diameter of full-form setting plug, and full portion of truncated setting plug. — Classes 2 and 3. — Max....	.7506	.8131	.8756	.9381	1.0006	1.0631	1.1256	1.1881	1.2506	1.3131	1.3756	1.4381	1.5006	1.5631
Major diameter of truncated portion of truncated setting plug. — Class 2.. — Min....	.7314	.7933	.8558	.9182	0.9807	1.0431	1.1055	1.1680	1.2304	1.2929	1.3553	1.4178	1.4802	1.5426
Major diameter of truncated portion of truncated setting plug. — Class 2.. — Max....	.7320	.7939	.8564	.9188	.9813	1.0437	1.1061	1.1686	1.2310	1.2935	1.3559	1.4184	1.4808	1.5432
Major diameter of truncated portion of truncated setting plug. — Class 3.. — Min....	.7327	.7949	.8573	.9198	.9822	1.0447	1.1071	1.1696	1.2321	1.2945	1.3570	1.4194	1.4819	1.5444
Major diameter of truncated portion of truncated setting plug. — Class 3.. — Max....	.7333	.7955	.8579	.9204	.9828	1.0453	1.1077	1.1702	1.2327	1.2951	1.3576	1.4200	1.4825	1.5450
Pitch diameter of setting plug or ring gages for production and inspection. — Class 2.. — Min....	.7049	.7668	.8293	.8917	.9542	1.0166	1.0790	1.1415	1.2039	1.2664	1.3288	1.3913	1.4537	1.5161
Pitch diameter of setting plug or ring gages for production and inspection. — Class 2.. — Max....	.7052	.7671	.8296	.8920	.9545	1.0169	1.0793	1.1418	1.2042	1.2667	1.3291	1.3916	1.4540	1.5165
Pitch diameter of setting plug or ring gages for production and inspection. — Class 3.. — Min....	.7062	.7684	.8308	.8933	.9557	1.0182	1.0806	1.1431	1.2056	1.2680	1.3305	1.3929	1.4554	1.5179
Pitch diameter of setting plug or ring gages for production and inspection. — Class 3.. — Max....	.7065	.7687	.8311	.8936	.9560	1.0185	1.0809	1.1434	1.2059	1.2683	1.3308	1.3932	1.4557	1.5183
(OPTIONAL)														
Pitch diameter of setting plug or ring gages for inspection (see par. 6, p. 31). — Class 2.. — Min....	.7046	.7665	.8290	.8914	.9539	1.0163	1.0787	1.1412	1.2036	1.2661	1.3285	1.3910	1.4534	1.5157
Pitch diameter of setting plug or ring gages for inspection (see par. 6, p. 31). — Class 2.. — Max....	.7049	.7668	.8293	.8917	.9542	1.0166	1.0790	1.1415	1.2039	1.2664	1.3288	1.3913	1.4537	1.5161
Pitch diameter of setting plug or ring gages for inspection (see par. 6, p. 31). — Class 3.. — Min....	.7059	.7681	.8305	.8930	.9554	1.0179	1.0803	1.1428	1.2053	1.2677	1.3302	1.3926	1.4551	1.5175
Pitch diameter of setting plug or ring gages for inspection (see par. 6, p. 31). — Class 3.. — Max....	.7062	.7684	.8308	.8933	.9557	1.0182	1.0806	1.1431	1.2056	1.2680	1.3305	1.3929	1.4554	1.5179
Minor diameter of ring gage..... — Class 2.. — Min....	.6914	.7533	.8158	.8782	.9407	1.0031	1.0655	1.1280	1.1904	1.2529	1.3153	1.3778	1.4402	1.5026
Minor diameter of ring gage..... — Class 2.. — Max....	.6920	.7539	.8164	.8788	.9413	1.0037	1.0661	1.1286	1.1910	1.2535	1.3159	1.3784	1.4408	1.5032
Minor diameter of ring gage..... — Class 3.. — Min....	.6927	.7549	.8173	.8798	.9422	1.0047	1.0671	1.1296	1.1921	1.2545	1.3170	1.3794	1.4419	1.5044
Minor diameter of ring gage..... — Class 3.. — Max....	.6933	.7555	.8179	.8804	.9428	1.0053	1.0677	1.1302	1.1927	1.2551	1.3176	1.3800	1.4425	1.5050

Limiting dimensions			Size (inches)												
			1⅝	1 1/16	1¾	1 13/16	1⅞	1 15/16	2	2 1/16	2⅛	2 3/16	2¼	2 5/16	2⅜	2 7/16
"Go" Gages for Screws																
			Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Classes 2 and 3.	Max....	1.6256	1.6881	1.7506	1.8131	1.8756	1.9381	2.0006	2.0631	2.1256	2.1881	2.2506	2.3131	2.3756	2.4381
		Min....	1.6250	1.6875	1.7500	1.8125	1.8750	1.9375	2.0000	2.0625	2.1250	2.1875	2.2500	2.3125	2.3750	2.4375
Major diameter of truncated portion of truncated setting plug.	Classes 2 and 3.	Max....	1.6160	1.6785	1.7410	1.8035	1.8660	1.9285	1.9910	2.0535	2.1160	2.1785	2.2410	2.3035	2.3660	2.4285
		Min....	1.6154	1.6779	1.7404	1.8029	1.8654	1.9279	1.9904	2.0529	2.1154	2.1779	2.2404	2.3029	2.3654	2.4279
Pitch diameter of setting plug or ring gage.	Classes 2 and 3.	Max Y..	1.5842	1.6467	1.7092	1.7717	1.8342	1.8967	1.9592	2.0217	2.0842	2.1467	2.2092	2.2717	2.3342	2.3967
		Min Y..	1.5836	1.6461	1.7086	1.7711	1.8336	1.8961	1.9586	2.0211	2.0836	2.1461	2.2086	2.2711	2.3336	2.3961
		Max X..	1.5844	1.6469	1.7094	1.7719	1.8344	1.8969	1.9594	2.0219	2.0844	2.1469	2.2094	2.2719	2.3344	2.3969
		Min X..	1.5840	1.6465	1.7090	1.7715	1.8340	1.8965	1.9590	2.0215	2.0840	2.1465	2.2090	2.2715	2.3340	2.3965
Minor diameter of ring gage.....	Classes 2 and 3.	Max....	1.5573	1.6198	1.6823	1.7448	1.8073	1.8698	1.9323	1.9948	2.0573	2.1198	2.1823	2.2448	2.3073	2.3698
		Min....	1.5567	1.6192	1.6817	1.7442	1.8067	1.8692	1.9317	1.9942	2.0567	2.1192	2.1817	2.2442	2.3067	2.3692
"Not Go" Gages for Screws																
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Classes 2 and 3.	Min....	1.6250	1.6875	1.7500	1.8125	1.8750	1.9375	2.0000	2.0625	2.1250	2.1875	2.2500	2.3125	2.3750	2.4375
		Max....	1.6256	1.6881	1.7506	1.8131	1.8756	1.9381	2.0006	2.0631	2.1256	2.1881	2.2506	2.3131	2.3756	2.4381
Major diameter of truncated portion of truncated setting plug.	Class 2..	Min....	1.6051	1.6676	1.7300	1.7925	1.8549	1.9174	1.9798	2.0423	2.1047	2.1672	2.2297	2.2921	2.3546	2.4170
		Max....	1.6057	1.6682	1.7306	1.7931	1.8555	1.9180	1.9804	2.0429	2.1053	2.1678	2.2303	2.2927	2.3552	2.4176
	Class 3..	Min....	1.6065	1.6693	1.7318	1.7942	1.8567	1.9192	1.9816	2.0441	2.1066	2.1691	2.2315	2.2940	2.3565	2.4189
		Max....	1.6074	1.6699	1.7324	1.7948	1.8573	1.9198	1.9822	2.0447	2.1072	2.1697	2.2321	2.2946	2.3571	2.4195
Pitch diameter of setting plug or ring gages for production and inspection.	Class 2..	Min....	1.5786	1.6411	1.7035	1.7660	1.8284	1.8909	1.9533	2.0158	2.0782	2.1407	2.2032	2.2656	2.3281	2.3905
		Max....	1.5790	1.6415	1.7039	1.7664	1.8288	1.8913	1.9537	2.0162	2.0786	2.1411	2.2036	2.2660	2.3285	2.3909
	Class 3..	Min....	1.5803	1.6428	1.7053	1.7677	1.8302	1.8927	1.9551	2.0176	2.0801	2.1426	2.2050	2.2675	2.3300	2.3924
		Max....	1.5807	1.6432	1.7057	1.7681	1.8306	1.8931	1.9555	2.0180	2.0805	2.1430	2.2054	2.2679	2.3304	2.3928
(Optional)																
Pitch diameter of setting plug or ring gages for inspection (see par. 6, p. 31).	Class 2..	Min....	1.5782	1.6407	1.7031	1.7656	1.8280	1.8905	1.9529	2.0154	2.0778	2.1403	2.2028	2.2652	2.3277	2.3901
		Max....	1.5786	1.6411	1.7035	1.7660	1.8284	1.8909	1.9533	2.0158	2.0782	2.1407	2.2032	2.2656	2.3281	2.3905
	Class 3..	Min....	1.5799	1.6424	1.7049	1.7673	1.8298	1.8923	1.9547	2.0172	2.0797	2.1422	2.2046	2.2671	2.3296	2.3920
		Max....	1.5803	1.6428	1.7053	1.7677	1.8302	1.8927	1.9551	2.0176	2.0801	2.1426	2.2050	2.2675	2.3300	2.3924
Minor diameter of ring gage.....	Class 2..	Min....	1.5651	1.6276	1.6900	1.7525	1.8149	1.8774	1.9398	2.0023	2.0647	2.1272	2.1897	2.2521	2.3146	2.3770
		Max....	1.5657	1.6282	1.6906	1.7531	1.8155	1.8780	1.9404	2.0029	2.0653	2.1278	2.1903	2.2527	2.3152	2.3776
	Class 3..	Min....	1.5668	1.6293	1.6918	1.7542	1.8167	1.8792	1.9416	2.0041	2.0666	2.1291	2.1915	2.2540	2.3165	2.3789
		Max....	1.5674	1.6299	1.6924	1.7548	1.8173	1.8798	1.9422	2.0047	2.0672	2.1297	2.1921	2.2546	2.3171	2.3795

TABLE 48.—*Limiting dimensions of setting plug and thread ring gages for screws of classes 2 and 3 fits, American National 16-pitch thread series*—Continued

Limiting dimensions			Size (inches)												
			2½	2⅝	2¾	2⅞	3	3⅛	3¼	3⅜	3½	3⅝	3¾	3⅞	4
"GO" GAGES FOR SCREWS															
			Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Classes 2 and 3.	Max....	2.5006	2.6256	2.7506	2.8756	3.0006	3.1256	3.2506	3.3756	3.5006	3.6256	3.7506	3.8756	4.0006
		Min....	2.5000	2.6250	2.7500	2.8750	3.0000	3.1250	3.2500	3.3750	3.5000	3.6250	3.7500	3.8750	4.0000
Major diameter of truncated portion of truncated setting plug.	Classes 2 and 3.	Max....	2.4910	2.6160	2.7410	2.8660	2.9910	3.1160	3.2410	3.3660	3.4910	3.6160	3.7410	3.8660	3.9910
		Min....	2.4904	2.6154	2.7404	2.8654	2.9904	3.1154	3.2404	3.3654	3.4904	3.6154	3.7404	3.8654	3.9904
Pitch diameter of setting plug or ring gage.....	Classes 2 and 3.	Max Y..	2.4592	2.5842	2.7092	2.8342	2.9592	3.0842	3.2092	3.3342	3.4592	3.5842	3.7092	3.8342	3.9592
		Min Y..	2.4586	2.5836	2.7086	2.8336	2.9586	3.0836	3.2086	3.3336	3.4586	3.5836	3.7086	3.8336	3.9586
		Max X..	2.4594	2.5844	2.7094	2.8344	2.9594	3.0844	3.2094	3.3344	3.4594	3.5844	3.7094	3.8344	3.9594
		Min X..	2.4590	2.5840	2.7090	2.8340	2.9590	3.0840	3.2090	3.3340	3.4590	3.5840	3.7090	3.8340	3.9590
Minor diameter of ring gage.....	Classes 2 and 3.	Max....	2.4323	3.5573	2.6823	2.8073	2.9323	3.0573	3.1823	3.3073	3.4323	3.5573	3.6823	3.8073	3.9323
		Min....	2.4317	2.5567	2.6817	2.8067	2.9317	3.0567	3.1817	3.3067	3.4317	3.5567	3.6817	3.8067	3.9317
"NOT GO" GAGES FOR SCREWS															
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Classes 2 and 3.	Min....	2.5000	2.6250	2.7500	2.8750	3.0000	3.1250	3.2500	3.3750	3.5000	3.6250	3.7500	3.8750	4.0000
		Max....	2.5006	2.6256	2.7506	2.8756	3.0006	3.1256	3.2506	3.3756	3.5006	3.6256	3.7506	3.8756	4.0006
Major diameter of truncated portion of truncated setting plug.	Class 2..	Min....	2.4795	2.6044	2.7293	2.8543	2.9792	3.1041	3.2290	3.3540	3.4789	3.6038	3.7288	3.8537	3.9787
		Max....	2.4801	2.6050	2.7299	2.8549	2.9798	3.1047	3.2296	3.3546	3.4795	3.6044	3.7294	3.8543	3.9793
	Class 3..	Min....	2.4814	2.6064	2.7313	2.8563	2.9812	3.1062	3.2311	3.3561	3.4810	3.6060	3.7309	3.8559	3.9808
		Max....	2.4820	2.6070	2.7319	2.8569	2.9818	3.1068	3.2317	3.3567	3.4816	3.6066	3.7315	3.8565	3.9814
Pitch diameter of setting plug or ring gages for production and inspection.	Class 2..	Min....	2.4530	2.5779	2.7028	2.8278	2.9527	3.0776	3.2025	3.3275	3.4524	3.5773	3.7023	3.8272	3.9522
		Max....	2.4534	2.5783	2.7032	2.8282	2.9531	3.0780	3.2029	3.3279	3.4528	3.5777	3.7027	3.8276	3.9526
	Class 3..	Min....	2.4549	2.5799	2.7048	2.8298	2.9547	3.0797	3.2046	3.3296	3.4545	3.5795	3.7044	3.8294	3.9543
		Max....	2.4553	2.5803	2.7052	2.8302	2.9551	3.0801	3.2050	3.3300	3.4549	3.5799	3.7048	3.8298	3.9547
(OPTIONAL)															
Pitch diameter of setting plug or ring gages for inspection (see par. 6, p. 31).	Class 2..	Min....	2.4526	2.5775	2.7024	2.8274	2.9523	3.0772	3.2021	3.3271	3.4520	3.5769	3.7019	3.8268	3.9518
		Max....	2.4530	2.5779	2.7028	2.8278	2.9527	3.0776	3.2025	3.3275	3.4524	3.5773	3.7023	3.8272	3.9522
	Class 3..	Min....	2.4545	2.5795	2.7044	2.8294	2.9543	3.0793	3.2042	3.3292	3.4541	3.5791	3.7040	3.8290	3.9539
		Max....	2.4549	2.5799	2.7048	2.8298	2.9547	3.0797	3.2046	3.3296	3.4545	3.5795	3.7044	3.8294	3.9543
Minor diameter or ring gage.....	Class 2..	Min....	2.4395	2.5644	2.6893	2.8143	2.9392	3.0641	3.1890	3.3140	3.4389	3.5638	3.6888	3.8137	3.9387
		Max....	2.4401	2.5650	2.6899	2.8149	2.9398	3.0647	3.1896	3.3146	3.4395	3.5644	3.6894	3.8143	3.9393
	Class 3..	Min....	2.4414	2.5664	2.6913	2.8163	2.9412	3.0662	3.1911	3.3161	3.4410	3.5660	3.6909	3.8159	3.9408
		Max....	2.4420	2.5670	2.6919	2.8169	2.9418	3.0668	3.1917	3.3167	3.4416	3.5666	3.6915	3.8165	3.9414

TABLE 49.—*Limiting dimensions of thread plug gages for nuts of classes 2 and 3 fits, American National 16-pitch thread series*

Limiting dimensions			Size (inches)													
			3/4	13/16	7/8	15/16	1	1 1/16	1 1/8	1 3/16	1 1/4	1 5/16	1 3/8	1 7/16	1 1/2	1 9/16
"GO" GAGES FOR NUTS																
			Inch	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage	Classes 2 and 3.	Min.	0.7500	0.8125	0.8750	0.9375	1.0000	1.0625	1.1250	1.1875	1.2500	1.3125	1.3750	1.4375	1.5000	1.5625
		Max.	.7506	.8131	.8756	.9381	1.0006	1.0631	1.1256	1.1881	1.2506	1.3131	1.3756	1.4381	1.5006	1.5631
Pitch diameter of plug gage	Classes 2 and 3.	Min Y.	.7096	.7721	.8346	.8971	.9596	1.0221	1.0846	1.1471	1.2096	1.2721	1.3346	1.3971	1.4596	1.5221
		Max Y.	.7100	.7725	.8350	.8975	.9600	1.0225	1.0850	1.1475	1.2100	1.2725	1.3350	1.3975	1.4600	1.5227
		Min X.	.7094	.7719	.8344	.8969	.9594	1.0219	1.0844	1.1469	1.2094	1.2719	1.3344	1.3969	1.4594	1.5219
		Max X.	.7097	.7722	.8347	.8972	.9597	1.0222	1.0847	1.1472	1.2097	1.2722	1.3347	1.3972	1.4597	1.5223
"NOT GO" GAGES FOR NUTS																
Major diameter of plug gage	Class 2..	Max.	.7410	.8041	.8666	.9292	.9917	1.0543	1.1169	1.1794	1.2420	1.3045	1.3671	1.4296	1.4922	1.5548
		Min.	.7404	.8035	.8660	.9286	.9911	1.0537	1.1163	1.1788	1.2414	1.3039	1.3665	1.4290	1.4916	1.5542
	Class 3..	Max.	.7397	.8025	.8651	.9276	.9902	1.0527	1.1153	1.1778	1.2403	1.3029	1.3654	1.4280	1.4905	1.5530
		Min.	.7391	.8019	.8645	.9270	.9896	1.0521	1.1147	1.1772	1.2397	1.3023	1.3648	1.4274	1.4899	1.5524
Pitch diameter of thread plug gages for production and inspection.	Class 2..	Max.	.7139	.7770	.8395	.9021	.9646	1.0272	1.0898	1.1523	1.2149	1.2774	1.3400	1.4025	1.4651	1.5277
		Min.	.7136	.7767	.8392	.9018	.9643	1.0269	1.0895	1.1520	1.2146	1.2771	1.3397	1.4022	1.4648	1.5273
	Class 3..	Max.	.7126	.7754	.8380	.9005	.9631	1.0256	1.0882	1.1507	1.2132	1.2758	1.3383	1.4009	1.4634	1.5259
		Min.	.7123	.7751	.8377	.9002	.9628	1.0253	1.0879	1.1504	1.2129	1.2755	1.3380	1.4006	1.4631	1.5255
(OPTIONAL)																
Pitch diameter of thread plug gages for inspection (see par. 6, p. 31).	Class 2..	Max.	.7142	.7773	.8398	.9024	.9649	1.0275	1.0901	1.1526	1.2152	1.2777	1.3403	1.4028	1.4654	1.5281
		Min.	.7139	.7770	.8395	.9021	.9646	1.0272	1.0898	1.1523	1.2149	1.2774	1.3400	1.4025	1.4651	1.5277
	Class 3..	Max.	.7129	.7757	.8383	.9008	.9634	1.0259	1.0885	1.1510	1.2135	1.2761	1.3386	1.4012	1.4637	1.5263
		Min.	.7126	.7754	.8380	.9005	.9631	1.0256	1.0882	1.1507	1.2132	1.2758	1.3383	1.4009	1.4634	1.5259

Limiting dimensions			Size (inches)													
			1 5/8	1 11/16	1 3/4	1 13/16	1 7/8	1 15/16	2	2 1/16	2 1/8	2 3/16	2 1/4	2 5/16	2 3/8	2 7/16
"GO" GAGES FOR NUTS																
			Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage	Classes 2 and 3.	Min.	1.6250	1.6875	1.7500	1.8125	1.8750	1.9375	2.0000	2.0625	2.1250	2.1875	2.2500	2.3125	2.3750	2.4375
		Max.	1.6256	1.6881	1.7506	1.8131	1.8756	1.9381	2.0006	2.0631	2.1256	2.1881	2.2506	2.3131	2.3756	2.4381
Pitch diameter of plug gage	Classes 2 and 3.	Min Y.	1.5846	1.6471	1.7096	1.7721	1.8346	1.8971	1.9596	2.0221	2.0846	2.1471	2.2096	2.2721	2.3346	2.3971
		Max Y.	1.5852	1.6477	1.7102	1.7727	1.8352	1.8977	1.9602	2.0227	2.0852	2.1477	2.2102	2.2727	2.3352	2.3977
		Min X.	1.5844	1.6469	1.7094	1.7719	1.8344	1.8969	1.9594	2.0219	2.0844	2.1469	2.2094	2.2719	2.3344	2.3969
		Max X.	1.5848	1.6473	1.7098	1.7723	1.8348	1.8973	1.9598	2.0223	2.0848	2.1473	2.2098	2.2723	2.3348	2.3973

TABLE 49.—*Limiting dimensions of thread plug gages for nuts of classes 2 and 3 fits, American National 16-pitch thread series*—Continued

Limiting dimensions			Size (inches)												
			1⅝	1 11/16	1¾	1 13/16	1⅞	1 15/16	2	2 1/16	2⅛	2 3/16	2¼	2 5/16	2⅜	2 7/16
"NOT GO" GAGES FOR NUTS			*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage	Class 2	Max.	1.6173	1.6798	1.7424	1.8049	1.8675	1.9300	1.9926	2.0551	2.1177	2.1802	2.2427	2.3053	2.3678	2.4304
		Min.	1.6167	1.6792	1.7418	1.8043	1.8669	1.9294	1.9920	2.0545	2.1171	2.1796	2.2421	2.3047	2.3672	2.4298
	Class 3	Max.	1.6156	1.6781	1.7406	1.8032	1.8657	1.9282	1.9908	2.0533	2.1158	2.1783	2.2409	2.3034	2.3659	2.4285
		Min.	1.6150	1.6775	1.7400	1.8026	1.8651	1.9276	1.9902	2.0527	2.1152	2.1777	2.2403	2.3028	2.3653	2.4279
Pitch diameter of thread plug gages for production and inspection.	Class 2	Max.	1.5902	1.6527	1.7153	1.7778	1.8404	1.9029	1.9655	2.0280	2.0906	2.1531	2.2156	2.2782	2.3407	2.4033
		Min.	1.5898	1.6523	1.7149	1.7774	1.8400	1.9025	1.9651	2.0276	2.0902	2.1527	2.2152	2.2778	2.3403	2.4029
	Class 3	Max.	1.5885	1.6510	1.7135	1.7761	1.8386	1.9011	1.9637	2.0262	2.0887	2.1512	2.2138	2.2763	2.3388	2.4014
		Min.	1.5881	1.6506	1.7131	1.7757	1.8382	1.9007	1.9633	2.0258	2.0883	2.1508	2.2134	2.2759	2.3384	2.4010
(OPTIONAL)																
Pitch diameter of thread plug gages for inspection (see par. 6, p. 31).	Class 2	Max.	1.5906	1.6531	1.7157	1.7782	1.8408	1.9033	1.9659	2.0284	2.0910	2.1535	2.2160	2.2786	2.3411	2.4037
		Min.	1.5902	1.6527	1.7153	1.7778	1.8404	1.9029	1.9655	2.0280	2.0906	2.1531	2.2156	2.2782	2.3407	2.4033
	Class 3	Max.	1.5889	1.6514	1.7139	1.7765	1.8390	1.9015	1.9641	2.0266	2.0891	2.1516	2.2142	2.2767	2.3392	2.4018
		Min.	1.5885	1.6510	1.7135	1.7761	1.8386	1.9011	1.9637	2.0262	2.0887	2.1512	2.2138	2.2763	2.3388	2.4014

Limiting dimensions			Size (inches)												
			2½	2⅝	2¾	2⅞	3	3⅛	3¼	3⅜	3½	3⅝	3¾	3⅞	4
"GO" GAGES FOR NUTS			*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage	Classes 2 and 3.	Min.	2.5000	2.6250	2.7500	2.8750	3.0000	3.1250	3.2500	3.3750	3.5000	3.6250	3.7500	3.8750	4.0000
		Max.	2.5006	2.6256	2.7506	2.8756	3.0006	3.1256	3.2506	3.3756	3.5006	3.6256	3.7506	3.8756	4.0006
Pitch diameter of plug gage	Classes 2 and 3.	Min Y.	2.4596	2.5846	2.7096	2.8346	2.9596	3.0846	3.2096	3.3346	3.4596	3.5846	3.7096	3.8346	3.9596
		Max Y.	2.4602	2.5852	2.7102	2.8352	2.9602	3.0852	3.2102	3.3352	3.4602	3.5852	3.7102	3.8352	3.9602
		Min X.	2.4594	2.5844	2.7094	2.8344	2.9594	3.0844	3.2094	3.3344	3.4594	3.5844	3.7094	3.8344	3.9594
		Max X.	2.4598	2.5848	2.7098	2.8348	2.9598	3.0848	3.2098	3.3348	3.4598	3.5848	3.7098	3.8348	3.9598
"NOT GO" GAGES FOR NUTS															
Major diameter of plug gage	Class 2	Max.	2.4929	2.6180	2.7431	2.8681	2.9932	3.1183	3.2434	3.3684	3.4935	3.6186	3.7436	3.8687	3.9937
		Min.	2.4923	2.6174	2.7425	2.8675	2.9926	3.1177	3.2428	3.3678	3.4929	3.6180	3.7430	3.8681	3.9931
	Class 3	Max.	2.4910	2.6160	2.7411	2.8661	2.9912	3.1162	3.2413	3.3663	3.4914	3.6164	3.7415	3.8665	3.9916
		Min.	2.4904	2.6154	2.7405	2.8655	2.9906	3.1156	3.2407	3.3657	3.4908	3.6158	3.7409	3.8659	3.9910
Pitch diameter of thread plug gages for production and inspection.	Class 2	Max.	2.4658	2.5909	2.7160	2.8410	2.9661	3.0912	3.2163	3.3413	3.4664	3.5915	3.7165	3.8416	3.9666
		Min.	2.4654	2.5905	2.7156	2.8406	2.9657	3.0908	3.2159	3.3409	3.4660	3.5911	3.7161	3.8412	3.9662
	Class 3	Max.	2.4639	2.5889	2.7140	2.8390	2.9641	3.0891	3.2142	3.3392	3.4643	3.5893	3.7144	3.8394	3.9645
		Min.	2.4635	2.5885	2.7136	2.8386	2.9637	3.0887	3.2138	3.3388	3.4639	3.5889	3.7140	3.8390	3.9641
(OPTIONAL)															
Pitch diameter of thread plug gages for inspection (see par. 6, p. 31).	Class 2	Max.	2.4662	2.5913	2.7164	2.8414	2.9665	3.0916	3.2167	3.3417	3.4668	3.5919	3.7169	3.8420	3.9670
		Min.	2.4658	2.5909	2.7160	2.8410	2.9661	3.0912	3.2163	3.3413	3.4664	3.5915	3.7165	3.8416	3.9666
	Class 3	Max.	2.4643	2.5893	2.7144	2.8394	2.9645	3.0895	3.2146	3.3396	3.4647	3.5897	3.7148	3.8398	3.9649
		Min.	2.4639	2.5889	2.7140	2.8390	2.9641	3.0891	3.2142	3.3392	3.4643	3.5893	3.7144	3.8394	3.9645

TABLE 50.—*Limiting dimensions of Y plain gages for screws and nuts of classes 2 and 3 fits, American National 16-pitch thread series*

Size	Gages for major diameter of screw				Gages for minor diameter of nut			
	"Go" gage		"Not go" gage		"Go" gage		"Not go" gage	
	Maximum	Minimum	Minimum	Maximum	Minimum	Maximum	Maximum	Minimum
1	2	3	4	5	6	7	8	9
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
3/4	0.75000	0.74993	0.74100	0.74107	0.68230	0.68237	0.69030	0.69023
13/16	.81250	.81243	.80350	.80357	.74480	.74487	.75280	.75273
7/8	.87500	.87491	.86600	.86609	.80730	.80737	.81530	.81523
15/16	.93750	.93741	.92850	.92859	.86980	.86989	.87780	.87771
1	1.00000	.99991	.99100	.99109	.93230	.93239	.94030	.94021
1 1/16	1.06250	1.06241	1.05350	1.05359	.99480	.99489	1.00280	1.00271
1 1/8	1.12500	1.12491	1.11600	1.11609	1.05730	1.05739	1.06530	1.06521
1 3/16	1.18750	1.18741	1.17850	1.17859	1.11980	1.11989	1.12780	1.12771
1 1/4	1.25000	1.24991	1.24100	1.24109	1.18230	1.18239	1.19030	1.19021
1 5/16	1.31250	1.31241	1.30350	1.30359	1.24480	1.24489	1.25280	1.25271
1 3/8	1.37500	1.37491	1.36600	1.36609	1.30730	1.30739	1.31530	1.31521
1 7/16	1.43750	1.43741	1.42850	1.42859	1.36980	1.36989	1.37780	1.37771
1 1/2	1.50000	1.49991	1.49100	1.49109	1.43230	1.43239	1.44030	1.44021
1 9/16	1.56250	1.56238	1.55350	1.55362	1.49480	1.49489	1.50280	1.50271
1 5/8	1.62500	1.62488	1.61600	1.61612	1.55730	1.55742	1.56530	1.56518
1 11/16	1.68750	1.68738	1.67850	1.67862	1.61980	1.61992	1.62780	1.62768
1 3/4	1.75000	1.74988	1.74100	1.74112	1.68230	1.68242	1.69030	1.69018
1 13/16	1.81250	1.81238	1.80350	1.80362	1.74480	1.74492	1.75280	1.75268
1 7/8	1.87500	1.87488	1.86600	1.86612	1.80730	1.80742	1.81530	1.81518
1 15/16	1.93750	1.93738	1.92850	1.92862	1.86980	1.86992	1.87780	1.87768
2	2.00000	1.99988	1.99100	1.99112	1.93230	1.93242	1.94030	1.94018
2 1/16	2.06250	2.06238	2.05350	2.05362	1.99480	1.99492	2.00280	2.00268
2 1/8	2.12500	2.12488	2.11600	2.11612	2.05730	2.05742	2.06530	2.06518
2 3/16	2.18750	2.18738	2.17850	2.17862	2.11980	2.11992	2.12780	2.12768
2 1/4	2.25000	2.24988	2.24100	2.24112	2.18230	2.18242	2.19030	2.19018
2 5/16	2.31250	2.31238	2.30350	2.30362	2.24480	2.24492	2.25280	2.25268
2 3/8	2.37500	2.37488	2.36600	2.36612	2.30730	2.30742	2.31530	2.31518
2 7/16	2.43750	2.43738	2.42850	2.42862	2.36980	2.36992	2.37780	2.37768
2 1/2	2.50000	2.49988	2.49100	2.49112	2.43230	2.43242	2.44030	2.44018
2 5/8	2.62500	2.62485	2.61600	2.61615	2.55730	2.55745	2.56530	2.56515
2 3/4	2.75000	2.74985	2.74100	2.74115	2.68230	2.68245	2.69030	2.69015
2 7/8	2.87500	2.87485	2.86600	2.86615	2.80730	2.80745	2.81530	2.81515
3	3.00000	2.99985	2.99100	2.99115	2.93230	2.93245	2.94030	2.94015
3 1/8	3.12500	3.12485	3.11600	3.11615	3.05730	3.05745	3.06530	3.06515
3 1/4	3.25000	3.24985	3.24100	3.24115	3.18230	3.18245	3.19030	3.19015
3 3/8	3.37500	3.37485	3.36600	3.36615	3.30730	3.30745	3.31530	3.31515
3 1/2	3.50000	3.49985	3.49100	3.49115	3.43230	3.43245	3.44030	3.44015
3 5/8	3.62500	3.62485	3.61600	3.61615	3.55730	3.55745	3.56530	3.56515
3 3/4	3.75000	3.74985	3.74100	3.74115	3.68230	3.68245	3.69030	3.69015
3 7/8	3.87500	3.87485	3.86600	3.86615	3.80730	3.80745	3.81530	3.81515
4	4.00000	3.99985	3.99100	3.99115	3.93230	3.93245	3.94030	3.94015

TABLE 51.—*Sizes of tap drills, American National 16-pitch thread series*

Size of thread	Threads per inch	Minor diameter of nut			Stock drills and corresponding percentage of basic thread depth		
		Basic	Maximum	Minimum	Nominal size	Diameter	Percentage of depth of basic thread
		Inch	*Inch*	*Inch*		*Inch*	
3/4	16	0.6688	0.6903	0.6823	11/16 in.	0.6875	77
					17.5 mm	.6890	75
13/16	16	.7313	.7528	.7448	19 mm	.7480	79
					3/4 in.	.7500	77
7/8	16	.7938	.8153	.8073	13/16 in.	.8125	77
15/16	16	.8563	.8778	.8698	7/8 in.	.8750	77
1	16	.9188	.9403	.9323	15/16 in.	.9375	77
1 1/16	16	.9813	1.0028	.9948	1 in.	1.0000	77
1 1/8	16	1.0438	1.0653	1.0573	1 1/16 in.	1.0625	77
					27 mm	1.0630	76
1 3/16	16	1.1063	1.1278	1.1198	28.5 mm	1.1220	81
					1 1/8 in.	1.1250	77
1 1/4	16	1.1688	1.1903	1.1823	1 3/16 in.	1.1875	77
1 5/16	16	1.2313	1.2528	1.2448	1 1/4 in.	1.2500	77
1 3/8	16	1.2938	1.3153	1.3073	1 5/16 in.	1.3125	77
1 7/16	16	1.3563	1.3778	1.3698	1 3/8 in.	1.3750	77
1 1/2	16	1.4188	1.4403	1.4323	36.5 mm	1.4370	78
					1 7/16 in.	1.4375	77
1 9/16	16	1.4813	1.5028	1.4948	38 mm	1.4961	82
					1 1/2 in.	1.5000	77
1 5/8	16	1.5438	1.5653	1.5573	1 9/16 in.	1.5625	77
1 11/16	16	1.6063	1.6278	1.6198	1 5/8 in.	1.6250	77
1 3/4	16	1.6688	1.6903	1.6823	1 11/16 in.	1.6875	77
1 13/16	16	1.7313	1.7528	1.7448	1 3/4 in.	1.7500	77
					44.5 mm	1.7520	75
1 7/8	16	1.7938	1.8153	1.8073	46 mm	1.8110	79
					1 13/16 in.	1.8125	77
1 15/16	16	1.8563	1.8778	1.8698	47.5 mm	1.8701	83
					1 7/8 in.	1.8750	77
2	16	1.9188	1.9403	1.9323	1 15/16 in.	1.9375	77
2 1/16	16	1.9813	2.0028	1.9948	2 in.	2.0000	77
2 1/8	16	2.0438	2.0653	2.0573	2 1/16 in.	2.0625	77
2 3/16	16	2.1063	2.1278	2.1198	2 1/8 in.	2.1250	77
					54 mm	2.1260	76
2 1/4	16	2.1688	2.1903	2.1823	55.5 mm	2.1850	80
					2 3/16 in.	2.1875	77
2 5/16	16	2.2313	2.2528	2.2448	2 1/4 in.	2.2500	77
2 3/8	16	2.2938	2.3153	2.3073	2 5/16 in.	2.3125	77
2 7/16	16	2.3563	2.3778	2.3698	2 3/8 in.	2.3750	77
2 1/2	16	2.4188	2.4403	2.4323	2 7/16 in.	2.4375	77
2 5/8	16	2.5438	2.5653	2.5573	65 mm	2.5590	81
					2 9/16 in.	2.5625	77
2 3/4	16	2.6688	2.6903	2.6823	2 11/16 in.	2.6875	77
2 7/8	16	2.7938	2.8153	2.8073	2 13/16 in.	2.8125	77
					71.5 mm	2.8150	74
3	16	2.9188	2.9403	2.9323	74.5 mm	2.9331	82
					2 15/16 in.	2.9375	77
3 1/8	16	3.0438	3.0653	3.0573	3 1/8 in.	3.0625	77
3 1/4	16	3.1688	3.1903	3.1823	3 3/16 in.	3.1875	77
3 3/8	16	3.2938	3.3153	3.3073	3 5/16 in.	3.3125	77
3 1/2	16	3.4188	3.4403	3.4323	3 7/16 in.	3.4375	77

8. AERONAUTICAL SCREW THREAD SERIES

The thread sizes listed in table 52, which include selections from the standard thread series in this section, shall be used in aircraft and aeronautical equipment. When the nature of the design requires thread sizes not included in table 52, threads of American National form, and preferably conforming to the specifications in section V herein, shall be used when specifically authorized.

TABLE 52.—*Aeronautic screw thread series, recommended selections from standard thread series*

Size	Basic major diameter	Thread series					Size	Basic major diameter	Thread series			
		NC	NF	NEF	8N	12N			NEF	8N	12N	16N
		Threads per inch							Threads per inch			
1	2	3	4	5	6	7	1	2	5	6	7	8
	Inches							*Inches*				
0	0.0600	.....	80	.....	.....	.....	1½	1.5000	18	8	12	.....
1	.0730	64	72	.....	.....	.....	1 9/16	1.5625	18	.....	.....	.....
2	.0860	56	64	.....	.....	.....	1⅝	1.6250	18	8	12	.....
3	.0990	48	56	.....	.....	.....	1 11/16	1.6875	18	.....	.....	.....
4	.1120	40	48	.....	.....	.....	1¾	1.7500	16	8	12	16
5	.1250	40	44	.....	.....	.....	1 13/16	1.8125	.....	.....	.....	16
6	.1380	32	40	.....	.....	.....	1⅞	1.8750	.....	8	12	16
8	.1640	32	36	.....	.....	.....	1 15/16	1.9375	.....	.....	.....	16
10	.1900	24	32	.....	.....	.....	2	2.0000	16	8	12	16
¼	.2500	20	28	32	.....	.....	2 1/16	2.0625	.....	.....	.....	16
5/16	.3125	18	24	32	.....	.....	2⅛	2.1250	.....	8	12	16
⅜	.3750	16	24	32	.....	.....	2 3/16	2.1875	.....	.....	.....	16
7/16	.4375	14	20	28	.....	.....	2¼	2.2500	.....	8	12	16
½	.5000	13	20	28	.....	.....	2 5/16	2.3125	.....	.....	.....	16
9/16	.5625	12	18	24	.....	.....	2⅜	2.3750	.....	.....	12	16
⅝	.6250	11	18	24	.....	.....	2 7/16	2.4375	.....	.....	.....	16
11/16	.6875	.....	.....	24	.....	.....	2½	2.5000	.....	8	12	16
¾	.7500	10	16	20	.....	.....	2⅝	2.6250	.....	.....	12	16
13/16	.8125	.....	.....	20	.....	.....	2¾	2.7500	.....	8	12	16
⅞	.8750	9	14	20	.....	.....	2⅞	2.8750	.....	.....	12	16
15/16	.9375	.....	.....	20	.....	.....	3	3.0000	.....	8	12	16
1	1.0000	8	14	20	.....	.....	3⅛	3.1250	.....	.....	12	16
1 1/16	1.0625	.....	.....	18	.....	12	3¼	3.2500	.....	8	12	16
1⅛	1.1250	.....	.....	18	8	12	3⅜	3.3750	.....	.....	12	16
1 3/16	1.1875	.....	.....	18	.....	12	3½	3.5000	.....	8	12	16
1¼	1.2500	.....	.....	18	8	12	3⅝	3.6250	.....	.....	12	16
1 5/16	1.3125	.....	.....	18	.....	12	3¾	3.7500	.....	8	12	16
1⅜	1.3750	.....	.....	18	8	12	3⅞	3.8750	.....	.....	12	16
1 7/16	1.4375	.....	.....	18	.....	12	4	4.0000	.....	8	12	16

SECTION V. SCREW THREADS OF SPECIAL DIAMETERS, PITCHES, AND LENGTHS OF ENGAGEMENT

The tolerances specified in section III of this report apply in general to bolts, nuts, and tapped holes of standard pitches and diameters. They are based on the pitch of the thread and a length of engagement equal to the basic major diameter, but are used for lengths of engagement up to 1½ diameters.

In addition to the foregoing threaded components, there are large quantities of threaded parts produced, such as hub and radiator caps in the automotive industry, threaded collars on machine tools, etc., where the diameters are larger, the pitches finer, and the lengths of engagement shorter than for bolt and nut practice. The following specifications have been adopted for such threaded parts, and the tolerances are based on the diameter, pitch, and length of engagement of the components.

1. FORM OF THREAD

The American National form of thread profile as specified in section III shall be used.

For screw threads of American National form but of special diameters, pitches, and lengths of engagement, the symbol "NS" shall be used. For example, a 1-inch, 18-pitch gage of American National form of thread, class 3 fit, shall be marked: 1"—18NS—3. See "Symbols," p. 4, regarding designation of "nonstandard" threads.

2. STANDARD PITCHES

In section IV there are given the limiting dimensions for standard thread series. The use of these series, wherever possible, is recommended for all applications.

Whenever sizes and pitches in the American National coarse, fine, or extra-fine, or the 8-, 12-, or 16-pitch thread series are not suitable, it is recommended that one of the following pitches be selected: 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 28, 32, 36, 40, 48, 56, 64 threads per inch.

Basic thread data for these pitches are given in table 53, and also in table 1.

3. CLASSIFICATION AND TOLERANCES

There are established herein for general use four classes of screw-thread fits, which are named and numbered to correspond to the regular classification of fits given in section III. These four classes, together with the accompanying specifications, are intended to insure a uniform practice for screw threads not included in the American National coarse, fine, or extra-fine thread series, nor in the 8-, 12-, or 16-pitch thread series.

It is not the intention of the committee arbitrarily to place a general class or grade of work in a specific class of fit. Each manufacturer and user of screw threads is free to select the class of fit best adapted to his particular needs.

TABLE 53.—*Thread data for recommended pitches for special threads*

Threads per inch, n	Pitch, p	Depth of thread, h	Basic width of flat, $p/8$	Minimum width of flat at major diameter of nut, $p/24$
1	2	3	4	5
	Inch	*Inch*	*Inch*	*Inch*
64.....	0.01562	0.01015	0.00195	0.00065
56.....	.01786	.01160	.00223	.00074
48.....	.02083	.01353	.00260	.00087
40.....	.02500	.01624	.00312	.00104
36.....	.02778	.01804	.00347	.00116
32.....	.03125	.02030	.00391	.00130
28.....	.03571	.02320	.00446	.00149
24.....	.04167	.02706	.00521	.00174
20.....	.05000	.03248	.00625	.00208
18.....	.05556	.03608	.00694	.00231
16.....	.06250	.04059	.00781	.00260
14.....	.07143	.04639	.00893	.00298
12.....	.08333	.05413	.01042	.00347
10.....	.10000	.06495	.01250	.00417
8.....	.12500	.08119	.01562	.00521
6.....	.16667	.10825	.02083	.00694
4.....	.25000	.16238	.03125	.01042

(a) GENERAL SPECIFICATIONS

The following general specifications apply to all classes of fit specified for screw threads of special diameters, pitches, and lengths of engagement.

1. UNIFORM MINIMUM NUT.—The pitch diameter of the minimum threaded hole or nut corresponds to the basic size.[14]

2. TOLERANCES.—(*a*) The tolerances specified represent the extreme variations allowed on the product.

(*b*) The tolerance on the nut is plus, and is applied from the basic size to above basic size.

(*c*) The tolerance on the screw is minus, and is applied from the maximum screw size to below the maximum screw size.

(*d*) The pitch diameter tolerances for a screw and nut of a given class of fit are the same.

(*e*) Pitch diameter tolerances include all errors of pitch diameter, lead, and angle. The full tolerance cannot, therefore, be used on pitch diameter unless the lead and angle of the thread are perfect.

(*f*) The pitch diameter tolerances are obtained by adding three values, or increments; one dependent upon the basic major diameter, another upon the length of engagement, and the third upon the pitch of the thread. These increments are based on formulas given in appendix 1, p. 222. However, where tolerance values so obtained exceed

[14] Special cases will arise, however, when a class 1 thread is required on finished drawn tubing with thin walls, and in such cases the allowance should be made on the nut.

those given in section III for corresponding pitches of the American National coarse or fine thread series, and for any diameters equal to or less than these standard sizes and lengths of engagement equal to or less than one diameter, the tolerances given in section III are used. (See rules for using tolerance tables on p. 108.)

(*g*) The tolerances on the major diameters of the screws and minor diameters of the nuts are based on the pitch of the thread, as these control the depth of engagement; they are, therefore, based on the pitch alone.

(*h*) The minimum minor diameter of a screw of a given pitch is such as to result in a basic flat ($\frac{1}{8} \times p$) at the root when the pitch diameter of the screw is at its minimum value. When the maximum screw is basic, the minimum minor diameter of the screw will be below the basic minor diameter by the amount of the specified pitch diameter tolerance.

(*i*) The maximum minor diameter of a screw of a given pitch may be such as results from the use of a worn or rounded threading tool, when the pitch diameter is at its maximum value. In no case, however, should the form of the screw, as results from tool wear, be such as to cause the screw to be rejected on the maximum minor diameter by a "go" thread ring gage, the minor diameter of which is equal to the minimum minor diameter of the nut.

(*j*) The maximum major diameter of the nut of a given pitch is such as to result in a flat equal to one-third of the basic flat ($\frac{1}{24} \times p$) when the pitch diameter of the nut is at its maximum value. When the minimum nut is basic, its maximum major diameter will be above the basic major diameter by the amount of the specified pitch diameter tolerance plus two-ninths of the basic thread depth.

(*k*) The nominal minimum major diameter of a nut is the basic major diameter. In no case, however, should the minimum major diameter of the nut, as results from a worn tap or cutting tool, be such as to cause the nut to be rejected on the minimum major diameter by a "go" plug gage made to the maximum major diameter of the screw.

(*l*) The tolerance on minor diameter of a nut of a given pitch is one-sixth of the basic thread depth regardless of the class of fit.[15]

(b) CLASSIFICATION OF FITS

1. CLASS 1 FIT.—This class is intended to cover the manufacture of threaded parts where quick and easy assembly is necessary and where an allowance is required.

This class is made with an allowance on the screw, so as to permit ready assembly, even when the threads are slightly bruised or dirty, in conformity with the practice in section III.[16]

Tables 54 and 55 give the limiting dimensions and tolerances for major, pitch, and minor diameters of threads of special diameters, pitches, and lengths of engagement.

2. CLASS 2 FIT.—This class is intended to apply to the major portion of threaded work in interchangeable manufacture, where no allowance is required. It is the same in every particular as class 1 except that it has no allowance and the tolerances are smaller.

Tables 54 and 56 give the limiting dimensions and tolerances for major, pitch, and minor diameters of threads of special diameters, pitches, and lengths of engagement.

3. CLASS 3 FIT.—This class is intended to apply to the higher grade of interchangeable screw-thread work. It is the same as class 2 in every particular except that the tolerances are smaller.

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[15] Special threads having a length of engagement considerably less than one diameter will not develop the full strength of the screw. The minimum minor diameter of the nut of the American National form of thread is such as to provide a minimum clearance on diameter at the minor diameter equal to two-ninths of the basic thread depth. If this clearance is reduced by providing a greater percentage of thread depth in the nut, the strength of such a fastening is increased. In such cases when the screw is subject to considerable tension, it is permissible to make the minor diameter of the nut less than the minimum specified in order to give the necessary depth of engagement.

On the other hand, when the length of engagement is exceptionally long the minor diameter of the nut may be greater than the maximum specified without impairing the strength of the fastening.

[16] See footnote 14 p. 106.

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Tables 54 and 57 give the limiting dimensions and tolerances for major, pitch, and minor diameters of threads of special diameters, pitches, and lengths of engagement.

4. Class 4 Fit.—This class is intended for threaded work requiring a fine, snug fit, and where a screw driver or wrench may be necessary for assembly.

In the manufacture of screw-thread products belonging to this class it may be necessary to use precision tools, gages made to special tolerances for this class (see table 9, p. 37), and other refinements. This quality of work should, therefore, be used only in cases where requirements of the mechanism being produced are exacting. In order to secure the fit desired, it may be necessary in some cases to select the parts when the product is being assembled.

The maximum pitch diameters of the screws are slightly larger than the minimum pitch diameters of the nuts determined from table 54.

Tables 54 and 58 give the limiting dimensions and tolerances for major, pitch, and minor diameters of threads of special diameters, pitches, and lengths of engagement.

4. TABLES OF DIMENSIONS

In order to simplify the specification of dimensions of special fastening screw threads, tables 54, 55, 56, 57, and 58 are arranged herein, and are intended to cover all practical combinations of diameter, pitch, length of engagement, and class of fit. The use of these tables instead of the application of formulas to determine limiting dimensions of a special thread facilitates placing dimensions on drawings. Also, in cases of special threads of the same diameter, pitch, and class of fit, but slightly different lengths of engagement, the threads may be gaged by a single set of gages, as identical pitch diameter tolerances will be applied.

(*a*) Arrangement of Tables.—The arrangement of dimensions and tolerances given in these tables has the following features:

All thread dimensions of threads of special diameters, pitches, and lengths of engagement, except pitch diameter tolerances are derived from table 54.

Pitch diameter tolerances are taken from tables 55, 56, 57, or 58, depending upon the class of fit required. These pitch diameter tolerances were obtained by adding increments[17] corresponding to the major diameters at the top, the threads per inch at the side of the table, and mean lengths of engagement of ¼, 1, and 2¼ inches for pitches from 64 to 12 threads per inch, inclusive, and ½, 2, and 4½ inches for pitches from 10 to 4 threads per inch, inclusive. Thus, the increments of the pitch diameter tolerances based on length of engagement and on diameter vary by difinite steps instead of continuously. However, in order that the tolerances given in these tables might be wholly consistent with those given in section III, certain values as listed are greater or less than those yielded by the above method. This modification was made by inserting in the tables, in the positions corresponding to standard sizes, pitches, and lengths of engagement of the American National coarse- and fine- thread series, the pitch diameter tolerances listed in section III. Then, wherever necessary, all values above and to the left of these inserted values were reduced so that none of them should exceed these standard values, and those below and to the right were increased so that none should be less than the standard values. This has the important advantage that in a series of sizes, frequently occuring in practice, consisting partly of standard sizes and partly of special sizes, there will be no undue irregularity in the progression of the pitch diameter tolerance, with consequent difficulties in securing gages, etc.

The maximum pitch diameter tolerances listed are equal to the tolerances on the major diameter of the screws of the same pitch, as given in table 54.

(*b*) Rules for Use of Tables.—For consistent application of the pitch diameter tolerance tables to all cases, adherence to the following rules relative to the use of the tables is necessary:

1. Tolerances on pitch diameter corresponding to major diameters between those

[17] The formulas for determining such increments are listed on p. 222.

for which values are given in the tables shall be those of the next larger diameter.

2. Tolerances on pitch diameter for pitches between those for which values are given in the tables shall be those of the next coarser pitch, except that for screws having 80, 72, 44, 13, 11, 9, 7, 5, or 4½ threads per inch, lengths of engagement of one and one half diameters or less, and diameters less than the standard diameters for the respective pitches as given in section IV, the tolerances given in section III shall be used.

3. Tolerances on pitch diameter for pitches coarser than 4 threads per inch shall be the same as those for 4 threads per inch.

4. Tolerances on pitch diameter when the length of engagement is exactly ½, or 1½, inches for 12 threads per inch and finer, or 1, or 3, inches for pitches coarser than 12 threads per inch, shall correspond to the interval of which these are the upper limits.

5. Tolerances on pitch diameter for lengths of engagement greater than those for which values are given shall be the maximum values listed for the pitch concerned.

(*c*) EXAMPLES.—The following examples illustrate the use of these tables:

Example: 3¼-inch, 16-thread, class 1 fit, with allowance on screw, one-half-inch length of engagement:

From table 55:
Pitch diameter tolerance..... = 0.0095
Also from table 54, for the screw:
Maximum major diameter = 3.2500 - .0018 = 3.2482
Minimum major diameter = 3.2482 - .0126 = 3.2356
Maximum minor diameter = 3.2500 - .0785 = 3.1715
Maximum pitch diameter = 3.2500 - .0424 = 3.2076
Minimum pitch diameter = 3.2076 - .0095 = 3.1981
And for the nut:
Minimum major diameter..... = 3.2500
Minimum minor diameter = 3.2500 - .0677 = 3.1823
Maximum minor diameter = 3.1823 + .0068 = 3.1891
Minimum pitch diameter = 3.2500 - .0406 = 3.2094
Maximum pitch diameter = 3.2094 + .0095 = 3.2189

Example: 3-inch, 24-thread, class 2 fit, five eighths inch length of engagement:

From table 56:
Pitch diameter tolerance..... = 0.0066

In this instance the pitch diameter tolerance is printed in italics. In accordance with the footnote under table 56 it is desirable to avoid the use of tolerances set in italics as the combination of class of fit, length of engagement, pitch, and diameter is disproportionate. If it is decided to use a closer fit, class 3 fit or class 4 fit may be chosen. Assuming the choice of class 3 fit, the following dimensions are obtained:

From table 57:
Pitch diameter tolerance..... = 0.0065
From table 54 for the screw:
Maximum major diameter..... = 3.0000
Minimum major diameter = 3.0000 - 0.0066 = 2.9934
Maximum minor diameter = 3.0000 - .0511 = 2.9489
Maximum pitch diameter = 3.0000 - .0271 = 2.9729
Minimum pitch diameter = 2.9729 - .0065 = 2.9664
And for the nut:
Minimum major diameter..... = 3.0000
Minimum minor diameter = 3.0000 - .0451 = 2.9549
Maximum minor diameter = 2.9549 + .0045 = 2.9594
Minimum pitch diameter = 3.0000 - .0271 = 2.9729
Maximum pitch diameter = 2.9729 + .0065 = 2.9794

If, instead, it is decided to reduce the length of engagement to one half inch, the following dimensions are obtained:

From table 56:
Pitch diameter tolerance..... = 0.0060
From table 54 for the screw:
Maximum major diameter..... = 3.0000
Minimum major diameter = 3.0000 - .0066 = 2.9934
Maximum minor diameter = 3.0000 - .0511 = 2.9489
Maximum pitch diameter = 3.0000 - .0271 = 2.9729
Minimum pitch diameter = 2.9729 - .0060 = 2.9669
And for the nut:
Minimum major diameter..... = 3.0000
Minimum minor diameter = 3.0000 - .0451 = 2.9549
Maximum minor diameter = 2.9549 + .0045 = 2.9594
Minimum pitch diameter = 3.0000 - .0271 = 2.9729
Maximum pitch diameter = 2.9729 + .0060 = 2.9789

5. GAGES

The classification of gages as presented in section III, division 3, "Gages," applies also to gages for special threads. Gage tolerances for W, X, and Y gages are given in tables 9, 10, and 11.

In ordering gages for a special thread, the length of engagement of the component thread (as distinct from the length of the gage), and the diameter, pitch, and class

of fit, should be stated, in order that the minimum-metal product limit, (pitch diameter of "not go" gage) may be determined correctly. With regard to the length of the "go" gage, and gage tolerances, for threads of exceptionally long lengths of engagement, the following practices are recommended: (1) For threads of classes 1 or 2, use the standard length of "go" gage as given in Commercial Standard CS8-41, and apply X tolerances; (2) for threads of classes 3 or 4, make the length of the "go" gage equal to the length of engagement and apply W cumulative tolerances in table 9 per inch of thread.

With regard to the marking of gages, each gage shall be plainly marked, for identification, with the diameter, pitch, thread series—that is, "NS" to indicate a special thread of American National form—and class of fit. See p. 106.

TABLE 54.—*Values for obtaining thread dimensions of special screw threads, classes 1, 2, 3, and 4 fits*

Threads per inch	SCREW SIZES To obtain maximum dimensions for major, pitch, and minor diameters, subtract the values in the "maximum" columns from the basic major diameter. Apply tolerances minus. See tables 55, 56, 57, and 58 for pitch diameter tolerances.									NUT SIZES To obtain minimum dimensions for minor, pitch, and major diameters, subtract the values in the "minimum" columns from the basic major diameter. Apply tolerances plus. See tables 55, 56, 57, and 58 for pitch diameter tolerances.			
	Major diameter				Pitch diameter, maximum			Minor diameter[1] maximum		Minor diameter		Pitch diameter, minimim	Major diameter[2] minimum
	Maximum		Tolerance							Minimum	Tolerance		
	Class 1	Classes 2, 3, 4	Class 1	Classes 2, 3, 4	Class 1	Classes 2, 3	Class 4	Class 1	Classes 2, 3, 4	Classes 1, 2, 3, and 4			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
64	0.0007	0.0000	0.0052	0.0038	0.0108	0.0101	0.0100	0.0199	0.0192	0.0169	0.0017	0.0101	0.0000
56	.0008	.0000	.0056	.0040	.0124	.0116	.0114	.0227	.0219	.0193	.0019	.0116	.0000
48	.0009	.0000	.0062	.0044	.0144	.0135	.0133	.0265	.0256	.0226	.0023	.0135	.0000
40	.0010	.0000	.0068	.0048	.0172	.0162	.0160	.0317	.0307	.0271	.0027	.0162	.0000
36	.0011	.0000	.0072	.0050	.0191	.0180	.0178	.0352	.0341	.0301	.0030	.0180	.0000
32	.0011	.0000	.0076	.0054	.0214	.0203	.0201	.0394	.0383	.0338	.0034	.0203	.0000
28	.0012	.0000	.0086	.0062	.0244	.0232	.0230	.0450	.0438	.0387	.0039	.0232	.0000
24	.0013	.0000	.0092	.0066	.0284	.0271	.0268	.0524	.0511	.0451	.0045	.0271	.0000
20	.0015	.0000	.0102	.0072	.0340	.0325	.0322	.0628	.0613	.0541	.0054	.0325	.0000
18	.0016	.0000	.0114	.0082	.0377	.0361	.0358	.0698	.0682	.0601	.0060	.0361	.0000
16	.0018	.0000	.0126	.0090	.0424	.0406	.0402	.0785	.0767	.0677	.0068	.0406	.0000
14	.0021	.0000	.0140	.0098	.0485	.0464	.0460	.0897	.0876	.0773	.0077	.0464	.0000
12	.0024	.0000	.0158	.0112	.0565	.0541	.0536	.1046	.1022	.0902	.0090	.0541	.0000
10	.0028	.0000	.0184	.0128	.0678	.0650	.0644	.1255	.1227	.1083	.0108	.0650	.0000
8	.0034	.0000	.0222	.0152	.0846	.0812	.0805	.1568	.1534	.1353	.0135	.0812	.0000
6	.0044	.0000	.0290	.0202	.1127	.1083	.1074	.2089	.2045	.1804	.0180	.1083	.0000
4	.0064	.0000	.0408	.0280	.1688	.1624	.1611	.3131	.3067	.2706	.0270	.1624	.0000

[1] Dimensions given for the maximum minor diameter of the screw are figured to the intersection of the worn tool arc with a center line through crest and root. The minimum minor diameter of the screw shall be that corresponding to a flat at the minor diameter of the minimum screw equal to $\frac{1}{8} \times p$, and may be determined by subtracting the basic thread depth, h (or $0.6495p$) from the minimum pitch diameter of the screw.

[2] Dimensions for the minimum major diameter of the nut correspond to the basic flat ($\frac{1}{8} \times p$), and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the nut shall be that corresponding to a flat at the major diameter of the maximum nut equal to $\frac{1}{24} \times p$, and may be determined by adding $1\frac{2}{9} \times h$ (or $0.7939p$) to the maximum pitch diameter of the nut.

TABLE 55.—*Pitch diameter tolerances for special screw threads, class 1 fit*

Threads per inch	Lengths of engagement		Pitch diameter tolerances for diameters up to and including—																				
	From—	To and including—	1/16 inch	1/8 inch	3/16 inch	1/4 inch	3/8 inch	1/2 inch	3/4 inch	1 inch	1 1/2 inches	2 inches	3 inches	4 inches	6 inches	8 inches	10 inches	12 inches	14 inches	16 inches	18 inches	20 inches	24 inches
	Inches	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
64	.....	1/2	0.0026	0.0026	0.0034	0.0038	0.0042	0.0044	0.0047	0.0050	0.0052	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
56	.....	1/2	.0028	.0028	.0034	.0038	.0044	.0046	.0049	.0052	.0056	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	1/2	1 1/2	.0052	.0054	.0055	.0056	*.0056*	*.0056*	*.0056*	*.0056*	*.0056*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
48	.....	1/2	.0031	.0031	.0034	.0038	.0046	.0048	.0051	.0054	.0058	0.0062	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	1/2	1 1/2	.0054	.0056	.0057	.0057	.0057	.0057	.0057	.0062	*.0062*	*.0062*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
40	.....	1/2	.0034	[1].0034	.0034	.0038	.0046	.0051	.0054	.0057	.0061	.0065	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	1/2	1 1/2	.0057	.0057	.0057	.0057	.0057	.0057	.0057	.0068	*.0068*	*.0068*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
36	.....	1/2	.....	.0036	.0036	.0038	.0046	.0051	.0056	.0058	.0063	.0067	0.0072	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	1/2	1 1/2	.....	.0057	.0057	.0057	.0057	.0057	.0057	.0070	.0072	*.0072*	*.0072*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
32	.....	1/2	.....	.0038	.0038	.0038	.0046	.0051	.0057	.0060	.0065	.0069	.0075	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	1/2	1 1/2	.....	.0057	.0057	.0057	.0057	.0057	.0057	.0070	.0076	*.0076*	*.0076*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
28	.....	1/2	.....	.....	.....	.0043	[2].0043	.0046	.0051	.0057	.0063	.0067	.0071	.0077	0.0083	.....	.....	.....	.....	.....	.....	.....	.....
	1/2	1 1/2	.....	.....	.0057	.0057	.0057	.0057	.0057	.0070	.0079	.0086	*.0086*	*.0086*	.....	.....	.....	.....	.....	.....	.....	.....	.....
24	.....	1/2	.....	.....	.0046	.0046	[2].0046	.0051	.0057	.0066	.0070	.0074	.0080	.0086	.....	.....	.....	.....	.....	.....	.....	.....	.....
	1/2	1 1/2	.....	.....	.0057	.0057	.0057	.0057	.0057	.0070	.0079	.0089	.0092	*.0092*	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	.....	1/2	.....	.....	.0051	[1].0051	.0051	[2].0051	.0057	.0070	.0074	.0078	.0084	.0090	0.0099	.....	.....	.....	.....	.....	.....	.....	.....
	1/2	1 1/2	.....	.....	.0057	.0057	.0057	.0057	.0057	.0070	.0079	.0093	.0099	.0102	*.0102*	.....	.....	.....	.....	.....	.....	.....	.....
	1 1/2	3	.....	.....	.0098	.0100	.0102	*.0102*	*.0102*	*.0102*	*.0102*	*.0102*	*.0102*	*.0102*	*.0102*	.....	.....	.....	.....	.....	.....	.....	.....
18	.....	1/2	.....	.....	.....	.0057	.0057	.0057	.0057	.0070	.0077	.0080	.0087	.0092	.0101	0.0109	0.0114	.....	.....	.....	.....	.....	.....
	1/2	1 1/2	.....	.....	.....	.0057	.0057	.0057	.0057	.0070	.0079	.0095	.0102	.0107	.0114	*.0114*	*.0114*	.....	.....	.....	.....	.....	.....
	1 1/2	3	.....	.....	.....	.0102	.0104	.0106	.0109	.0112	.0114	*.0114*	*.0114*	*.0114*	*.0114*	*.0114*	*.0114*	.....	.....	.....	.....	.....	.....
16	.....	1/2	.....	.....	.....	.0063	[1].0063	.0063	.0063	.0070	.0079	.0083	.0090	.0095	.0104	.0112	.0118	0.0124	.....	.....	.....	.....	.....
	1/2	1 1/2	.....	.....	.....	.0063	.0063	.0063	[2].0063	.0070	.0079	.0098	.0105	.0110	.0119	.0126	*.0126*	*.0126*	.....	.....	.....	.....	.....
	1 1/2	3	.....	.....	.....	.0105	.0107	.0109	.0112	.0115	.0120	.0123	.0126	*.0126*	*.0126*	*.0126*	*.0126*	*.0126*	.....	.....	.....	.....	.....
14	.....	1/2	.....	.....	.....	.....	.0070	.0070	.0070	.0070	.0079	.0087	.0093	.0099	.0108	.0115	.0122	.0128	0.0133	0.0138	.....	.....	.....
	1/2	1 1/2	.....	.....	.....	.....	.0070	.0070	.0070	[2].0070	.0079	.0102	.0108	.0114	.0123	.0130	.0137	.0140	*.0140*	*.0140*	.....	.....	.....
	1 1/2	3	.....	.....	.....	.....	.0111	.0113	.0116	.0119	.0123	.0127	.0133	.0139	.0140	*.0140*	*.0140*	*.0140*	*.0140*	*.0140*	.....	.....	.....
12	.....	1/2	.....	.....	.....	.....	.0075	.0077	.0079	.0079	.0079	.0091	.0097	.0103	.0112	.0119	.0126	.0132	.0138	.0143	0.0148	0.0152	.....
	1/2	1 1/2	.....	.....	.....	.....	.0079	.0079	.0079	.0079	[2].0079	.0106	.0112	.0118	.0127	.0134	.0141	.0147	.0153	.0158	*.0158*	*.0158*	.....
	1 1/2	3	.....	.....	.....	.....	.0115	.0117	.0120	.0123	.0127	.0131	.0137	.0143	.0152	.0158	*.0158*	*.0158*	*.0158*	*.0158*	*.0158*	*.0158*	.....
10	.....	1	.....	.....	.....	.....	.....	.0087	[1].0092	.0098	.0102	.0106	.0112	.0118	.0127	.0134	.0141	.0147	.0153	.0158	.0158	.0163	0.0171
	1	3	.....	.....	.....	.....	.....	.0117	.0120	.0123	.0128	.0132	.0138	.0143	.0152	.0160	.0166	.0172	.0178	.0183	*.0184*	*.0184*	*.0184*
	3	6	.....	.....	.....	.....	.....	.0167	.0171	.0173	.0178	.0181	.0184	*.0184*	*.0184*	*.0184*	*.0184*	*.0184*	*.0184*	*.0184*	*.0184*	*.0184*	*.0184*
8	.....	1	.....	.....	.....	.....	.....	.0095	.0098	[1].0111	.0111	.0111	.0115	.0121	.0130	.0137	.0144	.0150	.0156	.0161	.0166	.0170	.0179
	1	3	.....	.....	.....	.....	.....	.0125	.0128	.0131	.0135	.0139	.0145	.0151	.0160	.0167	.0174	.0180	.0186	.0191	.0196	.0200	.0209
	3	6	.....	.....	.....	.....	.....	.0175	.0178	.0181	.0185	.0189	.0195	.0201	.0210	.0217	.0222	*.0222*	*.0222*	*.0222*	*.0222*	*.0222*	*.0222*
6	.....	1	.....	.....	.....	.....	.....	.....	.0109	.0112	.0116	.0120	.0126	.0132	.0141	.0148	.0155	.0161	.0166	.0172	.0176	.0181	.0190
	1	3	.....	.....	.....	.....	.....	.....	.0139	.0142	[1].0145	.0150	.0156	.0162	.0171	.0178	.0185	.0191	.0196	.0202	.0206	.0211	.0220
	3	6	.....	.....	.....	.....	.....	.....	.0189	.0192	.0196	.0200	.0206	.0212	.0221	.0228	.0235	.0241	.0246	.0252	.0256	.0261	.0270
4	.....	1	.....	.....	.....	.....	.....	.....	.....	.0130	.0134	.0138	.0145	.0150	.0159	.0167	.0173	.0179	.0185	.0190	.0195	.0199	.0208
	1	3	.....	.....	.....	.....	.....	.....	.....	.0160	.0164	.0168	[1].0204	.0204	.0204	.0204	.0204	.0209	.0215	.0220	.0225	.0229	.0238
	3	6	.....	.....	.....	.....	.....	.....	.....	.0210	.0215	.0218	.0225	.0230	.0239	.0247	.0253	.0259	.0265	.0270	.0275	.0279	.0288

[1] Standard size of the American National coarse-thread series.

[2] Standard size of the American National fine-thread series.

NOTE.—It is preferable to avoid the use of tolerances set in italics by choosing a closer fit, shorter length of engagement, coarser pitch, or smaller diameter. When the length of engagement exceeds one diameter and the pitch diameter tolerance exceeds 90 percent of the major diameter tolerance, table 54, column 4, the major diameter tolerance shall be 110 percent of the pitch diameter tolerance.

TABLE 56.—*Pitch diameter tolerances for special screw threads, class 2 fit*

Threads per inch	Lengths of engagement		Pitch diameter tolerances for diameters up to and including—																				
	From—	To and including—	1/16 inch	1/8 inch	3/16 inch	1/4 inch	3/8 inch	1/2 inch	3/4 inch	1 inch	1 1/2 inches	2 inches	3 inches	4 inches	6 inches	8 inches	10 inches	12 inches	14 inches	16 inches	18 inches	20 inches	24 inches
	Inches	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
64	.....	½	0.0019	0.0019	0.0024	0.0027	0.0030	0.0032	0.0035	0.0038	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
56	.....	½	.0020	.0020	.0024	.0027	.0031	.0033	.0036	.0038	0.0040	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.0038	.0040	*.0040*	*.0040*	*.0040*	*.0040*	*.0040*	*.0040*	*.0040*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
48	.....	½	.0022	.0022	.0024	.0027	.0032	.0034	.0037	.0039	.0044	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.0039	.0041	.0041	.0041	.0041	.0041	.0041	.0044	*.0044*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
40	.....	½	.0024	[1].0024	.0024	.0027	.0033	.0035	.0038	.0041	.0045	0.0048	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.0041	.0041	.0041	.0041	.0041	.0041	.0041	.0048	*.0048*	*.0048*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
36	.....	½	.....	.0025	.0025	.0027	.0033	.0036	.0039	.0042	.0046	.0050	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.....	.0041	.0041	.0041	.0041	.0041	.0041	.0049	.0050	*.0050*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
32	.....	½	.....	.0027	.0027	.0027	.0033	.0036	.0040	.0043	.0047	.0051	0.0054	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.....	.0041	.0041	.0041	.0041	.0041	.0041	.0049	.0054	*.0054*	*.0054*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
28	.....	½	.....	.....	.0031	[2].0031	.0033	.0036	.0041	.0044	.0048	.0052	.0058	0.0062	.....	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.....	.....	.0041	.0041	.0041	.0041	.0041	.0049	.0056	.0062	*.0062*	*.0062*	.....	.....	.....	.....	.....	.....	.....	.....	.....
24	.....	½	.....	.....	.0033	.0033	[2].0033	.0036	.0041	.0045	.0050	.0054	.0060	.0065	.....	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.....	.....	.0041	.0041	.0041	.0041	.0041	.0049	.0056	.0066	*.0066*	*.0066*	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	.....	½	.....	.....	.0036	[1].0036	.0036	[2].0036	.0041	.0047	.0052	.0056	.0062	.0067	0.0072	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.....	.....	.0041	.0041	.0041	.0041	.0041	.0049	.0056	.0071	.0072	*.0072*	*.0072*	.....	.....	.....	.....	.....	.....	.....	.....
18	.....	½	.....	.....	.....	.0039	.0041	.0041	.0041	.0049	.0053	.0057	.0063	.0069	.0078	0.0082	.....	.....	.....	.....	.....	.....	.....
	½	1½	.....	.....	.....	.0041	.0041	.0041	.0041	.0049	.0056	.0072	.0078	.0082	*.0082*	*.0082*	.....	.....	.....	.....	.....	.....	.....
	1½	3	.....	.....	.....	.0079	.0081	.0082	*.0082*	*.0082*	*.0082*	*.0082*	*.0082*	*.0082*	*.0082*	*.0082*	.....	.....	.....	.....	.....	.....	.....
16	.....	½	.....	.....	.....	.0040	[1].0045	.0045	.0045	.0049	.0054	.0058	.0065	.0070	.0079	.0087	0.0090	.....	.....	.....	.....	.....	.....
	½	1½	.....	.....	.....	.0045	.0045	.0045	[2].0045	.0049	.0056	.0073	.0080	.0085	.0090	*.0090*	*.0090*	.....	.....	.....	.....	.....	.....
	1½	3	.....	.....	.....	.0080	.0082	.0084	.0087	.0090	*.0090*	*.0090*	*.0090*	*.0090*	*.0090*	*.0090*	.....	.....	.....	.....	.....	.....	.....
14	.....	½	.....	.....	.....	.....	.0045	.0048	.0049	.0049	.0056	.0060	.0066	.0072	.0081	.0088	.0095	0.0098	.....	.....	.....	.....	.....
	½	1½	.....	.....	.....	.....	.0049	.0049	.0049	[2].0049	.0056	.0075	.0081	.0087	.0096	.0098	*.0098*	*.0098*	.....	.....	.....	.....	.....
	1½	3	.....	.....	.....	.....	.0084	.0086	.0089	.0092	.0096	.0098	*.0098*	*.0098*	*.0098*	*.0098*	*.0098*	*.0098*	.....	.....	.....	.....	.....
12	.....	½	.....	.....	.....	.....	.0046	.0048	.0051	.0054	.0056	.0062	.0068	.0074	.0083	.0090	.0097	.0103	0.0109	0.0112	.....	.....	.....
	½	1½	.....	.....	.....	.....	.0056	.0056	.0056	[2].0056	.0077	.0083	.0089	.0098	.0105	.0112	*.0112*	*.0112*	*.0112*	*.0112*	.....	.....	.....
	1½	3	.....	.....	.....	.....	.0086	.0088	.0091	.0094	.0098	.0100	.0108	.0112	*.0112*	*.0112*	*.0112*	*.0112*	*.0112*	*.0112*	.....	.....	.....
10	.....	1	.....	.....	.....	.....	.....	.....	.0056	[1].0064	.0069	.0073	.0077	.0083	.0089	.0098	.0105	.0112	.0112	.0116	.0122	.0126	0.0128
	1	3	.....	.....	.....	.....	.....	.0088	.0091	.0094	.0098	.0100	.0108	.0112	.0121	.0128	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	.....
	3	6	.....	.....	.....	.....	.....	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	.....
8	.....	1	.....	.....	.....	.....	.....	.0060	.0064	[1].0076	.0076	.0077	.0083	.0089	.0098	.0105	.0112	.0115	.0120	.0125	.0130	.0135	0.0143
	1	3	.....	.....	.....	.....	.....	.0090	.0093	.0095	.0100	.0104	.0110	.0115	.0124	.0132	.0139	.0145	.0150	.0152	*.0152*	*.0152*	*.0152*
	3	6	.....	.....	.....	.....	.....	.0140	.0143	.0145	.0150	.0152	*.0152*	*.0152*	*.0152*	*.0152*	*.0152*	*.0152*	*.0152*	*.0152*	*.0152*	*.0152*	*.0152*
6	.....	1	.....	.....	.....	.....	.....	.....	.0068	.0076	.0076	.0079	.0085	.0091	.0100	.0107	.0114	.0120	.0126	.0131	.0136	.0140	.0149
	1	3	.....	.....	.....	.....	.....	.....	.0098	.0101	[1].0101	.0109	.0115	.0121	.0130	.0137	.0144	.0150	.0156	.0161	.0166	.0170	.0179
	3	6	.....	.....	.....	.....	.....	.....	.0148	.0151	.0155	.0159	.0165	.0171	.0180	.0187	.0194	.0200	.0202	*.0202*	*.0202*	*.0202*	*.0202*
4	.....	1	.....	.....	.....	.....	.....	.....	.....	.0080	.0084	.0088	.0095	.0100	.0109	.0117	.0123	.0129	.0135	.0140	.0145	.0149	.0158
	1	3	.....	.....	.....	.....	.....	.....	.....	.0110	.0114	.0118	[1].0140	.0140	.0140	.0147	.0153	.0159	.0165	.0170	.0175	.0179	.0188
	3	6	.....	.....	.....	.....	.....	.....	.....	.0160	.0164	.0168	.0175	.0180	.0189	.0197	.0203	.0209	.0215	.0220	.0225	.0229	.0238

[1]Standard size of the American National coarse-thread series.

[2]Standard size of the American National fine-thread series.

NOTE.—It is preferable to avoid the use of tolerances set in italics by choosing a closer fit, shorter length of engagement, coarser pitch, or smaller diameter. When the length of engagement exceeds one diameter and the pitch diameter tolerance exceeds 90 percent of the major diameter tolerance, table 54, column 5, the major diameter tolerance shall be 110 percent of the pitch diameter tolerance. Attention is directed to table 30 in the 1943 SAE Handbook, which is to be studied by the Committee as a substitute for the above table.

TABLE 57.—*Pitch diameter tolerances for special screw threads, class 3 fit*

Threads per inch	Lengths of engagement: From—	Lengths of engagement: To and including—	Pitch diameter tolerances for diameters up to and including— 1/16 inch	1/8 inch	3/16 inch	1/4 inch	3/8 inch	1/2 inch	3/4 inch	1 inch	1 1/2 inches	2 inches	3 inches	4 inches	6 inches	8 inches	10 inches	12 inches	14 inches	16 inches	18 inches	20 inches	24 inches
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
64	.....	½	0.0014	0.0014	0.0017	0.0019	0.0023	0.0025	0.0028	0.0031	0.0036	0.0038	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.0030	.0030	.0030	.0030	.0030	.0030	.0030	.0036	.0038	*.0038*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
56	.....	½	.0015	.0015	.0017	.0019	.0024	.0026	.0029	.0032	.0036	.0040	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.0030	.0030	.0030	.0030	.0030	.0030	.0030	.0036	.0040	*.0040*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
48	.....	½	.0016	.0015	.0017	.0019	.0024	.0026	.0029	.0032	.0037	.0041	0.0044	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.0030	.0030	.0030	.0030	.0030	.0030	.0030	.0036	.0040	.0044	*.0044*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
40	.....	½	.0017	[1].0017	.0017	.0019	.0024	.0026	.0030	.0033	.0037	.0041	.0048	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.0030	.0030	.0030	.0030	.0030	.0030	.0030	.0036	.0040	.0048	*.0048*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
36	.....	½	.....	.0018	.0018	.0019	.0024	.0026	.0030	.0033	.0038	.0042	.0048	0.0050	.....	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.....	.0030	.0030	.0030	.0030	.0030	.0030	.0036	.0040	.0050	*.0050*	*.0050*	.....	.....	.....	.....	.....	.....	.....	.....	.....
32	.....	½	.....	.0019	.0019	.0019	.0024	.0026	.0030	.0034	.0038	.0042	.0048	.0054	.....	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.....	.0030	.0030	.0030	.0030	.0030	.0030	.0036	.0040	.0054	*.0054*	*.0054*	.....	.....	.....	.....	.....	.....	.....	.....	.....
28	.....	½	.....	.....	.0022	[2].0022	.0024	.0026	.0030	.0034	.0039	.0043	.0049	.0054	0.0062	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.....	.....	.0030	.0030	.0030	.0030	.0030	.0036	.0040	.0058	.0062	*.0062*	*.0062*	.....	.....	.....	.....	.....	.....	.....	.....
24	.....	½	.....	.....	.0024	.0024	[2].0024	.0026	.0030	.0035	.0040	.0044	.0050	.0055	.0064	.....	.....	.....	.....	.....	.....	.....	.....
	½	1½	.....	.....	.0030	.0030	.0030	.0030	.0030	.0036	.0040	.0059	.0065	.0066	*.0066*	.....	.....	.....	.....	.....	.....	.....	.....
20	.....	½	.....	.....	.0025	[1].0026	.0026	[2].0026	.0030	.0036	.0040	.0045	.0051	.0056	.0065	0.0072	.....	.....	.....	.....	.....	.....	.....
	½	1½	.....	.....	.0030	.0030	.0030	.0030	.0030	.0036	.0040	.0060	.0066	.0071	.0072	*.0072*	.....	.....	.....	.....	.....	.....	.....
	1½	3	.....	.....	.0065	.0066	.0068	.0070	.0071	*.0071*	*.0071*	*.0072*	*.0072*	*.0072*	*.0072*	*.0072*	.....	.....	.....	.....	.....	.....	.....
18	.....	½	.....	.....	.....	.0027	.0030	.0030	.0030	.0036	.0040	.0045	.0051	.0057	.0066	.0073	0.0080	.....	.....	.....	.....	.....	.....
	½	1½	.....	.....	.....	.0030	.0030	.0030	.0030	.0036	.0040	.0060	.0066	.0072	.0081	.0082	*.0082*	.....	.....	.....	.....	.....	.....
	1½	3	.....	.....	.....	.0067	.0069	.0071	.0071	.0071	.0071	.0082	*.0082*	*.0082*	*.0082*	*.0082*	*.0082*	.....	.....	.....	.....	.....	.....
16	.....	½	.....	.....	.....	.0023	[1].0032	.0032	.0032	.0036	.0040	.0046	.0052	.0058	.0066	.0074	.0081	0.0087	.....	.....	.....	.....	.....
	½	1½	.....	.....	.....	.0032	.0032	.0032	[2].0032	.0036	.0040	.0061	.0067	.0073	.0081	.0089	.0090	*.0090*	.....	.....	.....	.....	.....
	1½	3	.....	.....	.....	.0068	.0070	.0071	.0071	.0071	.0071	.0084	.0090	*.0090*	*.0090*	*.0090*	*.0090*	*.0090*	.....	.....	.....	.....	.....
14	.....	½	.....	.....	.....	.....	.0032	.0036	.0036	.0036	.0040	.0047	.0053	.0058	.0067	.0075	.0082	.0088	0.0093	0.0098	.....	.....	.....
	½	1½	.....	.....	.....	.....	.0036	.0036	.0036	[2].0036	.0040	.0062	.0068	.0073	.0082	.0090	.0097	.0098	*.0098*	*.0098*	.....	.....	.....
	1½	3	.....	.....	.....	.....	.0071	.0071	.0071	.0071	.0071	.0084	.0092	.0098	*.0098*	*.0098*	*.0098*	*.0098*	*.0098*	*.0098*	.....	.....	.....
12	.....	½	.....	.....	.....	.....	.0032	.0036	.0040	.0040	.0040	.0048	.0054	.0059	.0068	.0076	.0083	.0089	.0094	.0099	0.0104	0.0109	.....
	½	1½	.....	.....	.....	.....	.0040	.0040	.0040	.0040	[2].0040	.0063	.0069	.0074	.0083	.0091	.0098	.0104	.0109	.0112	*.0112*	*.0112*	.....
	1½	3	.....	.....	.....	.....	.0071	.0071	.0071	.0071	.0071	.0084	.0092	.0099	.0108	.0112	*.0112*	*.0112*	*.0112*	*.0112*	*.0112*	*.0112*	.....
10	.....	1	.....	.....	.....	.....	.....	.....	.0040	[1].0045	.0054	.0059	.0063	.0069	.0074	.0083	.0091	.0098	.0104	.0109	.0112	.0112	.0115	0.0124
	1	3	.....	.....	.....	.....	.....	.....	.0071	.0071	.0071	.0071	.0084	.0092	.0099	.0108	.0112	.0119	.0125	.0128	*.0128*	*.0128*	*.0128*	*.0128*
	3	6	.....	.....	.....	.....	.....	.....	.0120	.0123	.0126	.0128	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*	*.0128*
8	.....	1	.....	.....	.....	.....	.....	.....	.0042	.0045	[1].0054	.0059	.0063	.0069	.0074	.0083	.0091	.0098	.0104	.0109	.0112	.0113	.0117	.0126
	1	3	.....	.....	.....	.....	.....	.....	.0071	.0071	.0071	.0071	.0086	.0092	.0099	.0108	.0114	.0121	.0127	.0132	.0138	.0143	.0147	.0152
	3	6	.....	.....	.....	.....	.....	.....	.0122	.0125	.0128	.0132	.0136	.0142	.0148	.0152	*.0152*	*.0152*	*.0152*	*.0152*	*.0152*	*.0152*	*.0152*	*.0152*
6	.....	1	.....	.....	.....	.....	.....	.....	.....	.0048	.0054	.0059	.0063	.0069	.0074	.0083	.0091	.0098	.0104	.0109	.0112	.0115	.0120	.0128
	1	3	.....	.....	.....	.....	.....	.....	.0071	.0071	[1].0071	.0089	.0095	.0100	.0109	.0117	.0124	.0130	.0135	.0140	.0145	.0150	.0158
	3	6	.....	.....	.....	.....	.....	.....	.0122	.0130	.0135	.0139	.0145	.0150	.0159	.0167	.0174	.0180	.0185	.0190	.0195	.0200	.0202
4	.....	1	.....	.....	.....	.....	.....	.....	.....	.0055	.0059	.0063	.0070	.0075	.0084	.0092	.0098	.0104	.0110	.0115	.0120	.0124	.0133
	1	3	.....	.....	.....	.....	.....	.....	.....	.0085	.0089	.0093	[1].0097	.0105	.0114	.0122	.0128	.0134	.0140	.0145	.0150	.0154	.0163
	3	6	.....	.....	.....	.....	.....	.....	.....	.0135	.0139	.0143	.0150	.0155	.0164	.0172	.0178	.0184	.0190	.0195	.0200	.0204	.0213

[1]Standard size of the American National coarse-thread series. [2]Standard size of the American National fine-thread series.

NOTE.—It is preferable to avoid the use of tolerances set in italics by choosing a closer fit, shorter length of engagement, coarser pitch, or smaller diameter. When the length of engagement exceeds one diameter and the pitch diameter tolerance exceeds 90 percent of the major diameter tolerance, table 54, column 5, the major diameter tolerance shall be 110 percent of the pitch diameter tolerance. Attention is directed to table 31 in the 1943 SAE Handbook, which is to be studied by the Committee as a substitute for the above table.

TABLE 58.—*Pitch diameter tolerances for special screw threads, class 4 fit*

Threads per inch	Lengths of engagement		Pitch diameter tolerances for diameters up to and including—																	
	From—	To and including—	¼ inch	⅜ inch	½ inch	¾ inch	1 inch	1½ inches	2 inches	3 inches	4 inches	6 inches	8 inches	10 inches	12 inches	14 inches	16 inches	18 inches	20 inches	24 inches
	Inches	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
28	.....	½	[1]0.0011	0.0012	0.0013	0.0015	0.0017	0.0019	0.0021	0.0024	0.0027	0.0032	0.0036	0.0039	0.0042	0.0045	0.0047	0.0050	0.0052	0.0056
	½	1½	.0015	.0015	.0015	.0015	.0018	.0020	.0029	.0032	.0035	.0039	.0043	.0046	.0049	.0052	.0055	.0057	.0059	.0062
	1½	3	.0032	.0033	.0034	.0036	.0036	.0036	.0041	.0044	.0047	.0052	.0056	.0059	.0062	*.0062*	*.0062*	*.0062*	*.0062*	*.0062*
24	.....	½	.0012	[1].0012	.0013	.0015	.0018	.0020	.0022	.0025	.0028	.0032	.0036	.0039	.0042	.0045	.0048	.0050	.0052	.0057
	½	1½	.0015	.0015	.0015	.0015	.0018	.0020	.0029	.0032	.0035	.0040	.0043	.0047	.0050	.0052	.0055	.0057	.0060	.0064
	1½	3	.0033	.0034	.0035	.0036	.0036	.0036	.0042	.0045	.0048	.0052	.0056	.0059	.0062	.0065	.0066	*.0066*	*.0066*	*.0066*
20	.....	½	[2].0013	.0013	[1].0013	.0015	.0018	.0020	.0022	.0025	.0028	.0033	.0036	.0040	.0043	.0046	.0048	.0050	.0053	.0057
	½	1½	.0015	.0015	.0015	.0015	.0018	.0020	.0030	.0033	.0036	.0040	.0044	.0047	.0050	.0053	.0056	.0058	.0060	.0065
	1½	3	.0033	.0034	.0035	.0036	.0036	.0036	.0042	.0045	.0048	.0053	.0056	.0060	.0063	.0066	.0068	.0070	.0072	.0072
18	.....	½	.0013	.0015	.0015	.0015	.0018	.0020	.0023	.0026	.0028	.0033	.0037	.0040	.0043	.0046	.0048	.0051	.0053	.0057
	½	1½	.0015	.0015	.0015	.0015	.0018	.0020	.0030	.0033	.0036	.0040	.0044	.0047	.0050	.0053	.0056	.0058	.0061	.0065
	1½	3	.0033	.0034	.0035	.0036	.0036	.0036	.0042	.0046	.0048	.0053	.0057	.0060	.0063	.0066	.0068	.0071	.0073	.0077
16	.....	½	.0014	[2].0016	.0016	.0016	.0018	.0020	.0023	.0026	.0029	.0033	.0037	.0040	.0043	.0046	.0049	.0051	.0053	.0058
	½	1½	.0016	.0016	.0016	[1].0016	.0018	.0020	.0030	.0033	.0036	.0041	.0044	.0048	.0051	.0054	.0056	.0059	.0061	.0065
	1½	3	.0034	.0035	.0036	.0036	.0036	.0036	.0042	.0046	.0049	.0053	.0057	.0060	.0063	.0066	.0069	.0071	.0073	.0078
14	.....	½	.....	.0016	.0018	.0018	.0018	.0020	.0023	.0026	.0029	.0034	.0038	.0041	.0044	.0047	.0049	.0052	.0054	.0058
	½	1½	.....	.0018	.0018	.0018	[1].0018	.0020	.0031	.0034	.0037	.0041	.0045	.0048	.0051	.0054	.0057	.0059	.0061	.0066
	1½	3	.....	.0035	.0036	.0036	.0036	.0036	.0042	.0046	.0049	.0054	.0058	.0061	.0064	.0067	.0069	.0072	.0074	.0078
12	.....	½	.....	.0016	.0018	.0020	.0020	.0020	.0024	.0027	.0030	.0034	.0038	.0041	.0044	.0047	.0050	.0052	.0054	.0059
	½	1½	.....	.0020	.0020	.0020	.0020	[1].0020	.0031	.0034	.0037	.0042	.0046	.0049	.0052	.0055	.0057	.0060	.0062	.0066
	1½	3	.....	.0036	.0036	.0036	.0036	.0036	.0042	.0046	.0050	.0054	.0058	.0061	.0064	.0067	.0070	.0072	.0074	.0079
10	.....	1	.....	.....	.0020	[2].0023	.0023	.0023	.0031	.0034	.0037	.0042	.0046	.0049	.0052	.0055	.0057	.0060	.0062	.0066
	1	3	.....	.....	.0036	.0036	.0036	.0036	.0042	.0046	.0050	.0054	.0058	.0061	.0064	.0067	.0070	.0072	.0074	.0079
	3	6	.....	.....	.0060	.0062	.0063	.0065	.0067	.0070	.0073	.0077	.0081	.0084	.0088	.0090	.0093	.0095	.0098	.0102
8	.....	1	.....	.....	.0021	.0023	[2].0027	.0027	.0031	.0034	.0037	.0042	.0046	.0049	.0052	.0055	.0057	.0060	.0062	.0066
	1	3	.....	.....	.0036	.0036	.0036	.0036	.0043	.0046	.0050	.0054	.0058	.0061	.0064	.0067	.0070	.0072	.0074	.0079
	3	6	.....	.....	.0061	.0062	.0064	.0066	.0068	.0071	.0074	.0078	.0082	.0085	.0088	.0091	.0094	.0096	.0099	.0103
6	.....	1	.....	.....	.....	.0024	.0027	.0027	.0031	.0034	.0037	.0042	.0046	.0049	.0052	.0055	.0057	.0060	.0062	.0066
	1	3	.....	.....	.....	.0036	.0036	[2].0036	.0044	.0047	.0050	.0055	.0058	.0062	.0065	.0068	.0070	.0073	.0075	.0079
	3	6	.....	.....	.....	.0064	.0065	.0067	.0069	.0072	.0075	.0080	.0083	.0087	.0090	.0093	.0095	.0098	.0100	.0104
4	.....	1	.....	.....	.....	.....	.0028	.0030	.0032	.0035	.0038	.0042	.0046	.0049	.0052	.0055	.0058	.0060	.0062	.0066
	1	3	.....	.....	.....	.....	.0043	.0045	.0047	[2].0048	.0053	.0057	.0061	.0064	.0067	.0070	.0073	.0075	.0077	.0082
	3	6	.....	.....	.....	.....	.0068	.0070	.0072	.0075	.0078	.0082	.0086	.0089	.0092	.0095	.0098	.0100	.0102	.0106

[1] Standard size of the American National fine-thread series.

[2] Standard size of the American National coarse-thread series.

NOTE.—It is preferable to avoid the use of tolerances set in italics by choosing a shorter length of engagement, coarser pitch, or smaller diameter. When the length of engagement exceeds one diameter and the pitch diameter tolerance exceeds 90 percent of the major diameter tolerance, table 54, column 5, the major diameter tolerance shall be 110 percent of the pitch diameter tolerance.

SECTION VI. AMERICAN NATIONAL PIPE THREADS[18]

The original American pipe-thread standard for taper threaded pipe joints was formulated prior to the year 1882 by Robert Briggs, of Philadelphia, Pa. After his death, a paper by Mr. Briggs containing detailed information regarding American pipe and pipe thread practice was read before the Institution of Civil Engineers of Great Britain. This is recorded in the Excerpt Minutes, Volume LXXI, Session 1882-1883, Part 1, of that society.

In 1886 the large majority of American manufacturers were threading pipe to practically the Briggs Standard, so acting jointly with The American Society of Mechanical Engineers they formally adopted it as a standard practice in that year and master thread plug and thick ring gages were made.

Later at various conferences representatives of the manufacturers and The American Society of Mechanical Engineers established additional sizes, certain details of gaging, tolerances, special applications of the standard, and in addition tabulated the formulas and dimensions more completely than was originally done by Mr. Briggs.

In 1913 a Committee on the Standardization of Pipe Threads was organized for the purpose of rediting and expanding the Briggs Standard, with the American Gas Association and The American Society of Mechanical Engineers as joint sponsors. After six years of work this committee completed the revised standard for taper pipe threads which was published in the A S M E "Transactions" of 1919, and was approved by the American Standards Association in December 1919. During this period the thin ring gage was established, and the crests of the thread plug and ring gages were truncated. This standard was adopted by, and appeared in the various reports of, the National Screw Thread Commission.

[18] This standard, in substantially the same form, has been adopted by the American Standards Association. It is published as ASA B2-1944, "American Standard Pipe Threads", by the ASME, 29 West 39th St., New York, N. Y. The specifications for gages are in agreement with Federal Specification GGG-P-351a, "Pipe Threads; Taper (American National)."

In the years which followed, the need for a further revision of this American Standards pamphlet was felt and the necessity of adding to it the recent developments in pipe threading practice. Accordingly, the Sectional Committee on the Standardization of Pipe Threads was organized in 1927. The specifications in this section are in agreement with the current standard developed by that Committee.

Substantially the same standard for taper pipe threads, but with various additional refinements in gaging, is issued as Army-Navy Aeronautical Specification AN-GGG-P-363.

1. SPECIFICATIONS FOR TAPER PIPE THREADS

The normal type of joint made with American National pipe threads is that employing an external taper and an internal taper thread. Other types of joints made with standard pipe threads are discussed in subsequent divisions of this section. The basic dimensions of these threads, derived from the following specifications, are given in table 59.

(a) FORM OF THREAD

The form of thread profile specified herein shall be known as the "American National taper pipe thread form."

There are shown in figure 22 the relations as specified herein for form of thread and general notation. Special notation is given in figure 23.

1. ANGLE OF THREAD.—The angle between sides of the thread is 60° when measured in an axial plane, and the line bisecting this angle is perpendicular to the axis.

2. DEPTH OF THREAD.—The (basic) maximum depth of the truncated thread, h, is $0.80p$ and is based on factors entering into the manufacture of cutting tools and the making of tight joints. The crest and root of thread are truncated a minimum of $0.033p$. The maximum depth of truncation for these pipe threads will be found in table 60.

The sketches at the head of table 60, giving a sectional view of this standard thread form, represent the truncated thread

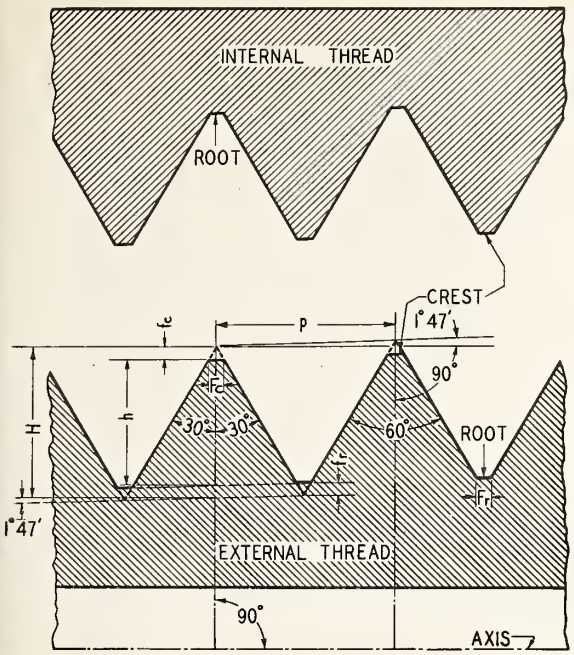


FIGURE 22.—*American National taper pipe thread form and notation.*

NOTATION

H = 0.866025p = depth of 60° sharp V thread[19]
h = 0.800000p = depth of thread on work.
p = $1/n$ = pitch (measured parallel to axis)
n = number of threads per inch
fc = depth of truncation at crest
fr = depth of truncation at root
Fc = width of flat at crest
Fr = width of flat at root

[19] For a symmetrical straight screw thread, $H = p/2 \cot a$. For a symmetrical taper screw thread $H = p/2 (\cot a - \tan^2 \beta \tan a)$, so that the exact value for an American National taper pipe thread is $H = 0.865743p$ as against $H = 0.866025p$, the value given above. For an 8-pitch thread, which is the coarsest standard taper pipe thread pitch, the corresponding values of H are 0.108218 inch and 0.108253 inch, respectively, the difference being 0.000035 inch. This difference being too small to be significant, the value of $H = 0.866025p$ continues in use for threads of three-fourths inch, or less, taper per foot.

form by a straight line. However, when closely examined, the crests and roots of commercially manufactured pipe threads appear slightly rounded, and it is intended that the pipe threads of product shall be acceptable when crest and root of the tools or chasers lie within the limits set up in table 60.

3. TAPER OF THREAD.—The taper of the taper pipe thread is 1 in 16, or 0.75 inch per foot, measured on the diameter and along the axis.

(b) BASIC DIMENSIONS AND SYMBOLS

1. SYMBOLS.[20]—American National taper pipe threads shall be identified by the symbol NPT. Example:

Threaded part 1 inch diameter, 11½ threads per inch, mark.....1"—11½NPT

The list of symbols given in section II, 3, together with additional symbols given below, should be used in formulas for expressing relations of pipe threads, on drawings, etc. Symbols such as *L1* and *E1* may either be written as shown or with the second character as a subscript. The latter is the practice followed in this text.

Outside diameter of pipe = maximum major diameter of pipe thread.....D
Internal diameter of pipe.....d
Distance from gaging notch to end of pipe = normal engagement by hand between external and internal threads.....L_1
Length of effective thread, external thread.....L_2
Length of effective thread, internal thread (normal wrench make-up).....L_3
Total length of external thread to last scratch..L_4
Length of perfect thread.....L_5
Pitch diameter of thread at end of pipe.....E_0
Pitch diameter of thread at gaging notch or large end of internal thread.....E_1
Pitch diameter of external thread at L_2 from end of pipe.....E_2
Pitch diameter of internal thread at L_3 from end of pipe.....E_3
Pitch diameter of external thread at L_5 from end of pipe.....E_5
Major diameter at end of pipe.....D_0
Minor diameter at end of pipe.....K_0

2. DIAMETERS OF THREADS.—The pitch diameters of the taper thread are determined by the following formulas based on the outside diameter of pipe and the pitch of thread:

$$E_0 = D - (0.05D + 1.1)\, 1/n$$
$$E_1 = E_0 + 0.0625L_1$$

3. LENGTH OF THREAD.—The length of the effective external taper thread, L_2, is determined by the following formula based on the outside diameter of the pipe and the pitch of the thread:

$$L_2 = (0.8D + 6.8).$$

[20] A complete list of suggested symbols and their definitions, for general application to taper threads, is given in appendix 6.

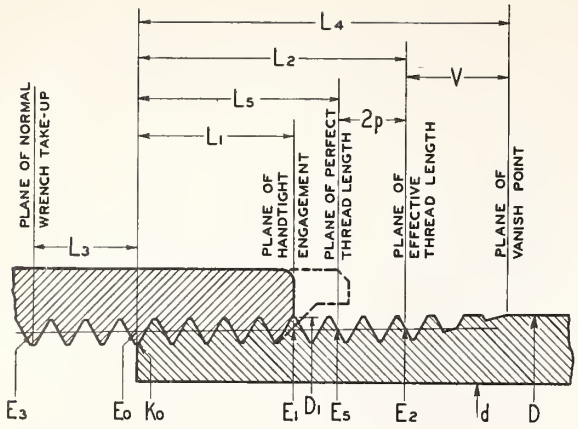


FIGURE 23.—*American National taper pipe thread notation.*

NOTATION

$$E_0 = D - (0.05D + 1.1)1/n$$
$$E_1 = E_0 + 0.0625L_1$$
$$L_3 = \left(\frac{0.8D + 6.8}{n}\right)$$

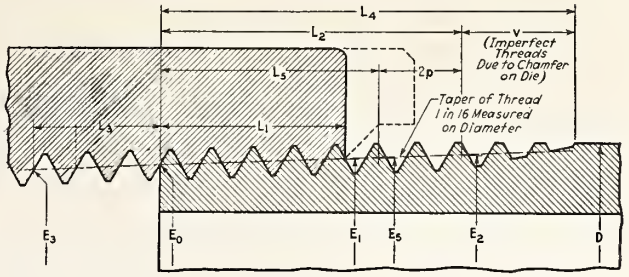
This formula determines directly the length of effective thread, which includes two usable threads slightly imperfect at the crest.

4. ENGAGEMENT BETWEEN EXTERNAL AND INTERNAL TAPER THREADS.—The normal length of engagement between external and internal taper threads, when screwed together by hand, is shown in columns 6 and 7 of table 59. This length is controlled by the construction and use of the gages. It is recognized that in special applications, such as flanges for high-pressure work, longer thread engagement is used, in which case the pitch diameter, E_1, is maintained and the pitch diameter, E_0, at the small end is proportionately smaller.

(c) MANUFACTURING TOLERANCES OF THREADED PRODUCT

1. MANUFACTURING TOLERANCE ON PRODUCT USING WORKING GAGES.—The maximum allowable variation in the commercial product is 1 turn large or 1 turn small from the gaging notch on plug and gaging face of ring when using working gages. (See figs. 27 and 28.) This is equivalent to a maximum allowable variation of the product of 1½ turns large or small from the basic dimensions, on account of the permissible allowance of ½ turn large or small on working gages.

TABLE 59.—*Basic dimensions of American National taper pipe threads*[1]



Nominal pipe size	Outside diameter of pipe, D	Threads per inch, n	Pitch of thread, p	Pitch diameter at beginning of external thread, E_0	Hand-tight engagement			Effective thread, external		
					Length,[2] L_1		Diam,[3] E_1	Length,[4] L_2		Diam, E_2
1	2	3	4	5	6	7	8	9	10	11
	Inches		*Inch*	*Inches*	*Inches*	*Thds*	*Inches*	*Inches*	*Thds*	*Inches*
1/16	0.3125	27	0.03704	0.27118	0.160	4.32	0.28118	0.2611	7.05	0.28750
1/8	.405	27	.03704	.36351	.180	4.86	.37476	.2639	7.12	.38000
1/4	.540	18	.05556	.47739	.200	3.60	.48389	.4018	7.23	.50250
3/8	.675	18	.05556	.61201	.240	4.32	.62701	.4078	7.34	.63750
1/2	.840	14	.07143	.75843	.320	4.48	.77843	.5337	7.47	.79179
3/4	1.050	14	.07143	.96768	.339	4.75	.98887	.5457	7.64	1.00179
1	1.315	11 1/2	.08696	1.21363	.400	4.60	1.23863	.6828	7.85	1.25630
1 1/4	1.660	11 1/2	.08696	1.55713	.420	4.83	1.58338	.7068	8.13	1.60130
1 1/2	1.900	11 1/2	.08696	1.79609	.420	4.83	1.82234	.7235	8.32	1.84130
2	2.375	11 1/2	.08696	2.26902	.436	5.01	2.29627	.7565	8.70	2.31630
2[7]	2.375	11 1/2	.08696	2.25453	.668	7.68	2.23627	.9884	11.37	2.31630
2 1/2	2.875	8	.12500	2.71953	.682	5.46	2.76216	1.1375	9.10	2.79062
3	3.500	8	.12500	3.34062	.766	6.13	3.38850	1.2000	9.60	3.41562
3 1/2	4.000	8	.12500	3.83750	.821	6.57	3.38881	1.2500	10.00	3.91562
4	4.500	8	.12500	4.33438	.844	6.75	4.38712	1.3000	10.40	4.41562
5	5.563	8	.12500	5.33073	.937	7.50	5.44929	1.4063	11.25	5.47862
6	6.625	8	.12500	6.44609	.958	7.66	6.50597	1.5125	12.10	6.54062
8	8.625	8	.12500	8.43359	1.063	8.50	8.50003	1.7125	13.70	8.54062
10	10.750	8	.12500	10.54531	1.210	9.68	10.62094	1.9250	15.40	10.66562
12	12.750	8	.12500	12.53281	1.360	10.88	12.61781	2.1250	17.00	12.66562
14 OD	14.000	8	.12500	13.77500	1.562	12.50	13.87262	2.2500	18.90	13.91562
16 OD	16.000	8	.12500	15.76250	1.812	14.50	15.87575	2.4500	19.60	15.91562
18 OD	18.000	8	.12500	17.75000	2.000	16.00	17.87500	2.6500	21.20	17.91562
20 OD	20.000	8	.12500	19.73750	2.125	17.00	19.87031	2.8500	22.80	19.91562
24 OD	24.000	8	.12500	23.71250	2.375	19.00	23.86094	3.2500	26.00	23.91562

Nominal pipe size	Effective thread, internal, or wrench makeup			Vanish threads, V		Total length of thread, L_4	Perfect threads[5]		Depth of thread, h	Increase in diam per thread, $\frac{0.0625}{n}$	Basic[6] minor diam at small end of pipe, K_0
	Length, L_3		Diam, E_3				Length, L_5	Diam, E_5			
1	12	13	14	15	16	17	18	19	20	21	22
Inches	*Inch*	*Thds*	*Inches*	*Inch*	*Thds*	*Inches*	*Inches*	*Inches*	*Inch*	*Inch*	*Inches*
1/16	0.1111	3	0.26424	0.1285	3.47	0.3896	0.1870	0.28287	0.02963	0.00231	0.2416
1/8	.1111	3	.35656	.1285	3.47	.3924	.1898	.37537	.02963	.00231	.3339
1/4	.1667	3	.46697	.1928	3.47	.5946	.2907	.49556	.04444	.00347	.4329
3/8	.1667	3	.60160	.1928	3.47	.6006	.2957	.63056	.04444	.00347	.5676
1/2	.2143	3	.74504	.2478	3.47	.7815	.3909	.78286	.05714	.00446	.7013
3/4	.2143	3	.95429	.2478	3.47	.7935	.4029	.99286	.05714	.00446	.9105
1	.2609	3	1.19733	.3017	3.47	.9845	.5088	1.24543	.06957	.00543	1.1441

[1] See footnotes at end of table.

TABLE 59.—*Basic dimensions of American National taper pipe threads*[1]—Continued

Nominal pipe size	Effective thread, internal, or wrench makeup: Length, L_3		Effective thread, internal, or wrench makeup: Diam, E_3	Vanish threads, V		Total length of thread, L_4	Perfect threads[5]: Length, L_5	Perfect threads[5]: Diam, E_5	Depth of thread, h	Increase in diam per thread, $\frac{0.0625}{n}$	Basic[6] minor diam at small end of pipe, K_0
1	12	13	14	15	16	17	18	19	20	21	22
Inches	*Inch*	*Thds*	*Inches*	*Inch*	*Thds*	*Inches*	*Inches*	*Inches*	*Inch*	*Inch*	*Inches*
1¼.....	.2609	3	1.54083	.3017	3.47	1.0085	.5329	1.59043	.06957	.00543	1.4876
1½.....	.2609	3	1.77978	.3017	3.47	1.0252	.5496	1.83043	.06957	.00543	1.7265
2.....	.2609	3	2.25272	.3017	3.47	1.0582	.5826	2.30543	.06957	.00543	2.1995
[7]2.....	.2609	3	2.25272	.3017	3.47	1.2901	.8145	2.30543	.....	.00543	2.1919
2½.....	[8] .2500	2	2.70391	.4337	3.47	1.5713	.8875	2.77500	.100000	.00781	2.6195
3.....	[8] .2500	2	3.32500	.4337	3.47	1.6337	.9500	3.40000	.100000	.00781	3.2406
3½.....	.2500	2	3.82188	.4337	3.47	1.6837	1.0000	3.90000	.100000	.00781	3.7375
4.....	.2500	2	4.31875	.4337	3.47	1.7337	1.0500	4.40000	.100000	.00781	4.2344
5.....	.2500	2	5.37511	.4337	3.47	1.8407	1.1563	5.46300	.100000	.00781	5.2907
6.....	.2500	2	6.43047	.4337	3.47	1.9467	1.2625	6.52500	.100000	.00781	6.3461
8.....	.2500	2	8.41797	.4337	3.47	2.1467	1.4625	8.52500	.100000	.00781	8.3336
10.....	.2500	2	10.52969	.4337	3.47	2.3587	1.6750	10.65000	.100000	.00781	10.4453
12.....	.2500	2	12.51719	.4337	3.47	2.5587	1.8750	12.65000	.100000	.00781	12.4328
14 OD.....	.2500	2	13.75938	.4337	3.47	2.6837	2.0000	13.90000	.100000	.00781	13.6750
16 OD.....	.2500	2	15.74688	.4337	3.47	2.8837	2.2000	15.90000	.100000	.00781	15.6625
18 OD.....	.2500	2	17.73438	.4337	3.47	3.0837	2.4000	17.90000	.100000	.00781	17.6500
20 OD.....	.2500	2	19.72188	.4337	3.47	3.2837	2.6000	19.90000	.100000	.00781	19.6375
24 OD.....	.2500	2	23.69688	.4337	3.47	3.6837	3.0000	23.90000	.100000	.00781	23.6125

[1] The basic dimensions of the American National taper pipe thread are given in inches to four or five decimal places. While this implies a greater degree of precision than is ordinarily attained, these dimensions are the basis of gage dimensions and are so expressed for the purpose of eliminating errors in computations.

[2] Also length of thin ring gage and length from gaging notch to small end of plug gage.

[3] Also pitch diameter at gaging notch (hand-tight plane.)

[4] Also length of plug gage.

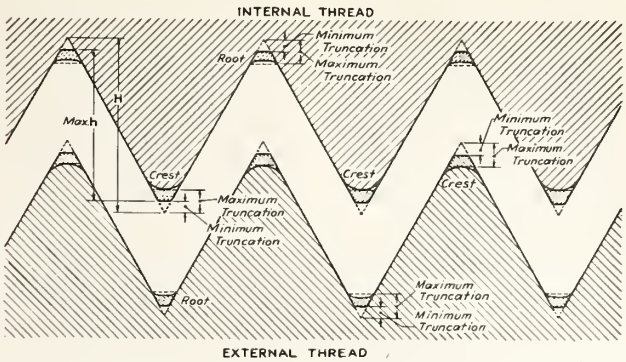
[5] The length L_5 from the end of the pipe determines the plane beyond which the thread form is imperfect at the crest. The next two threads are perfect at the root. At this plane the cone formed by the crests of the thread intersects the cylinder forming the external surface of the pipe. $L_5 = L_2 - 2p$.

[6] Given as information for use in selecting tap drills.

[7] API line pipe. (Not an American standard and tolerances in this standard do not apply.) This is the only size of line pipe that differs in length of thread from the American National standard. The standard thread chambers in the lower pressure fittings and valves do not accommodate this longer line-pipe thread.

[8] The Army-Navy Aeronautical Specifications are based on a wrench makeup of three threads. The dimensions are as follows: L_3, sizes 2½ and 3 in., 0.375; E_3, size 2½ in., 2.69609; and size 3 in., 3.31719.

TABLE 60.—*Limits on crest and root of American National external and internal taper pipe threads*



Threads per inch	Depth of sharp V thread, H	Depth of pipe thread		Truncation[1]			
		Maximum, h	Minimum	Minimum		Maximum[2]	
1	2	3	4	5	6	7	8
	Inch	*Inch*	*Inch*	*Formula*	*Inch*	*Formula*	*Inch*
27	0.03208	0.02963	0.02496	0.033p	0.0012	0.096p	0.0036
18	.04811	.04444	.03833	.033p	.0018	.088p	.0049
14	.06186	.05714	.05071	.033p	.0024	.078p	.0056
11½	.07531	.06957	.06261	.033p	.0029	.073p	.0063
8	.10825	.10000	.09275	.033p	.0041	.062p	.0078

Threads per inch	Tolerance or truncation	Width of flat				Tolerance on equivalent width of flat
		Minimum		Maximum[1]		
1	9	10	11	12	13	14
	Inch	*Formula*	*Inch*	*Formula*	*Inch*	*Inch*
27	0.0024	0.038p	0.0014	0.111p	0.0041	0.0027
18	.0031	.038p	.0021	.102p	.0057	.0036
14	.0032	.038p	.0027	.090p	.0064	.0037
11½	.0034	.038p	.0033	.084p	.0073	.0040
8	.0037	.038p	.0048	.072p	.0090	.0042

[1] Dimensions of gages, such as plain taper plug and ring gages, which depend on maximum and minimum truncations, cols. 5 to 8, inclusive, shall be determined by applying the thread depths in cols. 3 and 4 to the basic pitch diameter, E_0 or E_1. Step values of tolerance notches are 16 times (col. 3-col. 4), rather than 32 times col. 9. See par. (*c*), p. 123.

[2] The Army-Navy Aeronautical specification AN-GGG-P-363a agrees with all values given in this table except those for the maximum truncation and maximum width of flat for the 1/8 in.-27 size. These values are, respectively, 0.0027 and 0.0031 inch.

NOTE.—The basic dimensions of the American National taper pipe thread are given in inches to four and five decimal places. While this implies a greater degree of precision than is ordinarily attained, these dimensions are so expressed for the purpose of elimination errors in computations.

The limits specified in table 60 are intended to serve as a guide for establishing limits of the thread elements of taps, dies, and thread chasers. These limits may be required on product.

2. TOLERANCES ON THREAD ELEMENTS.—The permissible variations in thread elements on steel products and all pipe made of steel, wrought iron, or brass, exclusive of butt-weld pipe, are given in table 61.

On pipe fittings and valves (not steel) for steam pressures 300 lb. and below, it is intended that plug and ring gage practice, as set up in this standard, will provide for a satisfactory check of accumulated variations in such product of taper, lead, and angle. Therefore, no tolerances on thread elements have been established for this class.

For service conditions, where more exact check is required, procedures have been developed by industry to supplement the regulation plug and ring gage method of gaging. See pars. (d) 1(*b*) and (d) 1(*c*), p. 123.

TABLE 61.—*Tolerances on taper, lead, and angle of pipe threads of steel products and of all pipe of steel, wrought-iron, or brass*

Nominal pipe size (inches)	Threads per inch	Taper on pitch line per foot		Lead in length of effective thread[1]	60° angle of thread
		Maximum	Minimum		
		Inch	*Inch*	*Inch* ±	*Degrees* ±
1/16, 1/8.....	27	7/8	1 1/16	0.003	2 1/2
1/4, 3/8.....	18	7/8	1 1/16	.003	2
1/2, 3/4.....	14	27/32	1 1/16	.003	2
1, 1 1/4, 1 1/2, 2..	11 1/2	27/32	1 1/16	.003	1 1/2
2 1/2 and larger	8	13/16	23/32	.006	1 1/2

[1] The tolerance on lead shall be ±0.003 in. per in. on any size threaded to an effective thread length greater than 1 in.

NOTE.—For tolerances on depth of thread, see table 60, and for tolerances on pitch diameter, see par. (*c*)1, above. For tolerances on Dryseal threads, see table 66.

The limits specified in table 61 are intended to serve as a guide for establishing limits of the thread elements of taps, dies, and thread chasers. These limits may be required on product threads.

(d) GAGES AND GAGE TOLERANCES

1. DESIGN OF GAGES.—Gages for American National taper pipe threads shall be made of hardened steel and shall be of the standard type, or the limit type, as specified below. Gages shall conform to the designs recommended in Commercial Standard CS8-41 or applicable revision thereof, for plug gages of sizes 12-inch and smaller and for ring gages of sizes 8-inch and smaller. Larger sizes shall be of suitable design.

(*a*) *Standard type gages.*—A set of standard or basic type gages consists of a taper-threaded plug gage and a taper-threaded ring gage. (See figs. 24 and 25.) The plug gages are made to dimensions given in table 62 with a gaging notch located a distance L_1 from the small end. The thin ring gages have a

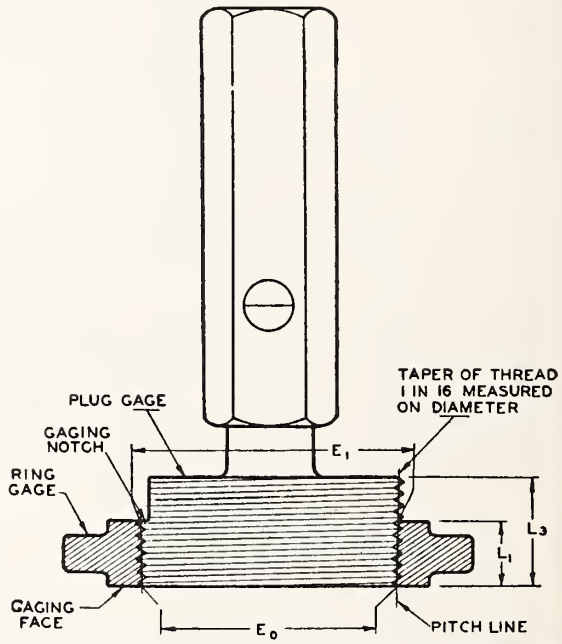


FIGURE 24.—*Standard taper pipe thread plug and ring gages.*

NOTE.— The illustration shows standard design for for sizes 2-inch and smaller; larger sizes are of slightly different designs.

length equal to dimension L_1. These rings are fitted to the plugs, coming flush at the notch. The roots of the threads on these gages should not be less than a sharp V. Preferably they may be undercut beyond the sharp V, to facilitate grinding, and the crests are truncated an amount equal to $0.100p$, as illustrated in figure 25. In locating the basic gaging notch, the plane of the bottom of the notch should intersect the following thread flank or side at or near the pitch cone.

The ring gage shall be fitted to the plug so that, when assembled handtight the gaging face will be flush with the small end of the plug, and the opposite face will be flush with the gaging notch on the plug.

(b) *Limit type gages.*—There are occasions when it is desirable to check the maximum and minimum limits of taper threaded product directly with a limit working gage rather than with a standard basic working gage, which necessitates counting the turns by which the gage over-travels or fails to come up to the basic surface on the product. To meet this requirement, the design of limit gage shown in figure 26 has been developed as an alternative to the recognized standard type plug and ring gages. These gages retain the basic notch on the plug together with the basic surface of the ring, and in addition include two notches, or steps, on both plug and ring, one the maximum and one the minimum. The retention of the basic step, or notch, facilitates checking against the master and reference gages and also provides a convenient means of checking the maximum and minimum steps. The limit gage thread form, tolerances, etc.

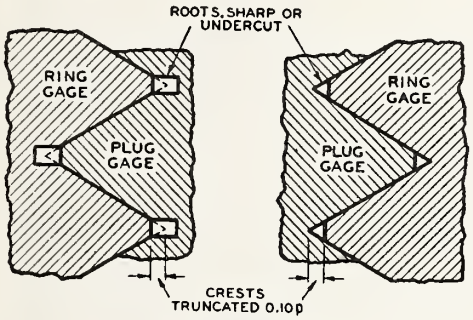


FIGURE 25.—*Recommended forms of gage threads.*

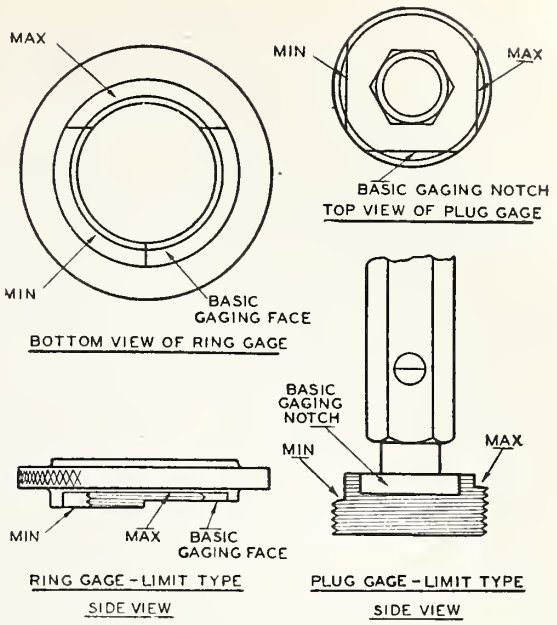


FIGURE 26.—*Limit type of taper pipe thread plug and ring gages.*

shall be as specified in this standard for the corresponding basic type gages.

(c) *Army-Navy aeronautical specification gages.*—A gaging system or combination of specially designed gages, which controls the individual thread elements more closely than either the standard type or limit type gages described above, is specified in the current issue of Army-Navy Aeronautical Specification AN-GGG-P-363. This system is summarized below, but for details reference should be made to the specification.

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1. INTERNAL THREADS.—The internal thread is first gaged with a limit-type taper thread plug gage, as described above under (*b*), which is known as the L_1 gage, and the gaging notch which most nearly represents the size of the thread is noted. The thread is then gaged with an L_3 taper thread plug gage, the length of which is equal to $L_1 + L_3$, but which has four threads at the small end only, with crest truncation greater than on the L_1 gage. For the thread to pass the gage, the position of the gaging notch must coincide with that of the L_1 gage within one-half turn. The L_1 gage has a crest truncation equal to the maximum truncation specified for the product, and the L_3 gage has a crest truncation of $0.15p$. These two gages together check the lead, taper, pitch diameter, and major diameter. The truncation of the crests at the minor diameter is checked by means of a plain taper plug gage having six notches, three of which represent the minimum truncation for the basic, maximum, and minimum thread sizes, and the other three of which represent the corresponding maximum truncation.

2. EXTERNAL THREADS.—(*a*) *Ring gages.*—The external thread is gaged with the thin taper thread ring gage known as the L_1 gage, and the thick taper thread ring gage, known as the L_2 gage. The L_1 gage has a crest truncation of $0.15p$, and the L_2 gage has a crest truncation equal to the maximum truncation specified for the product. These two gages together check the lead, taper, minor diameter, and pitch diameter. The truncation of the crest at the major diameter is checked by means of a plain taper ring gage having six gaging faces at one end, three of which represent the minimum truncation for the basic, maximum, and minimum thread sizes, and the other three of which represent the corresponding maximum truncation.

(*b*) *Triroll gages.*—The triroll taper pipe thread gage, which functions in a manner similar to a taper thread ring gage of the limit type, has the additional advantage that the taper, thread angle, lead, and thread form may be examined visually by observing the contact between the gage rolls and the thread. A plain taper triroll gage may also be used to gage major diameter; this gage permits measurement of taper error which may be examined visually, or for all practical purposes be measured by inserting two thickness gages between the gage rolls and the major diameter of the product, one on each side, at the point of extreme gap. This gage has a flush-pin arrangement with basic, maximum, and minimum steps on the body, which represent the thread size, and maximum and minimum steps on the flush-pin corresponding to the limits on crest truncation.

2. CLASSIFICATION OF GAGES.—Gages to maintain interchangeability of product properly should consist of:

1. Master gages used to check reference gages.
2. Reference gages used to check working gages.
3. Working and inspection gages used to check product.

(*a*) *Master gages.*—The set of master gages consists of taper threaded plug and ring gages of the standard type, and is primarily for the use of gage and tool manufacturers and for accurate comparison in checking reference gages.

The set of master gages should be made to the basic dimensions shown in table 62 as accurately as possible. Each master gage should in addition be accompanied by a record of the measurements of all elements of the thread.

(*b*) *Reference gages.*—The set of reference gages consists of taper threaded plug and ring gages of the standard type and are used primarily for checking working and inspection gages. These gages should be made to the basic dimensions shown in table 62, and should be within the tolerances for individual elements, as specified in table 63. Columns 3 to 7 of table 63 are used when checking gages by measurement.

Each reference gage should be accompanied by a record of the decimal part of a turn that it varies large or small from the basic dimensions, determined by the method stated below in par. (*c*).

CAUTION.—It must be understood that two gages will not necessarily mate in accordance with the computed value that each may be off from basic.

(c) *Working and inspection gages.*—The sets of working and inspection gages consist of taper thread plug and ring gages of either the standard type or the limit type, and are used for checking the product. These gages should be made to the basic dimensions shown in table 62 and should be within the tolerances for individual elements, as specified in table 63. Columns 3 to 7 of table 63 are used when checking gages by measurement.

(d) *Worn working-gage tolerances.*—The maximum wear on working gages shall not be more than the equivalent of one-half turn from the basic dimensions.

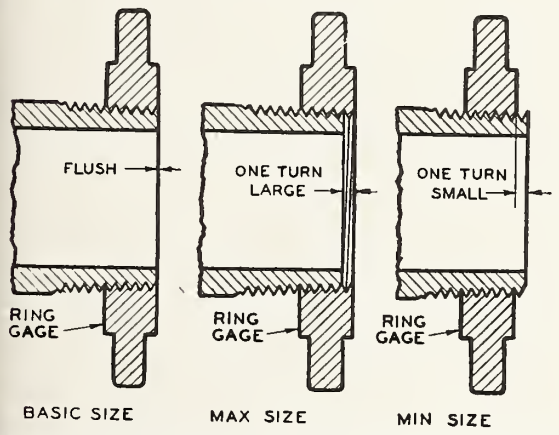


FIGURE 27.—*Gaging of external American National taper pipe threads with working gage.*

(e) *Relation of lead and angle errors to pitch diameter tolerances.*—When it is necessary to compute from measurements the decimal part of a turn that a gage varies from the basic dimensions, which is required for master and reference gages, tables 64 and 65 should be used. Table 64 gives the correction in diameter for angle errors, and table 65 gives the correction in diameter for lead errors. These corrections are always added to the pitch diameter, in the case of external threads, and subtracted in the case of internal threads, regardless of whether the lead or angle errors are plus or minus.

The correction in diameter for lead and angle errors, plus the pitch diameter errors, multiplied by 16, gives the longitudinal variation from basic at the gaging notch. This longitudinal variation divided by the pitch equals the decimal part of a turn that the gage varies from basic at the gaging notch.

3. METHODS OF GAGING PRODUCT.—(a) *Gaging external taper pipe threads.*—In gaging external taper threads, the ring gage is screwed up tight by hand on the external thread of the product. The thread is

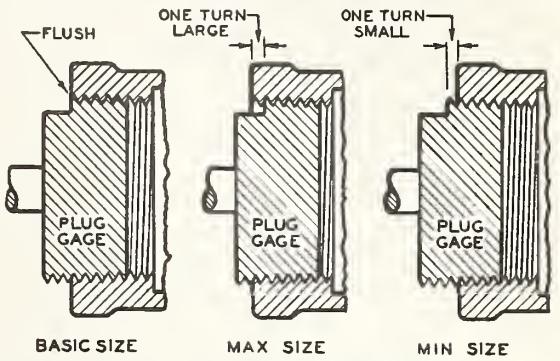


FIGURE 28.—*Gaging of internal American National taper pipe threads with working gage.*

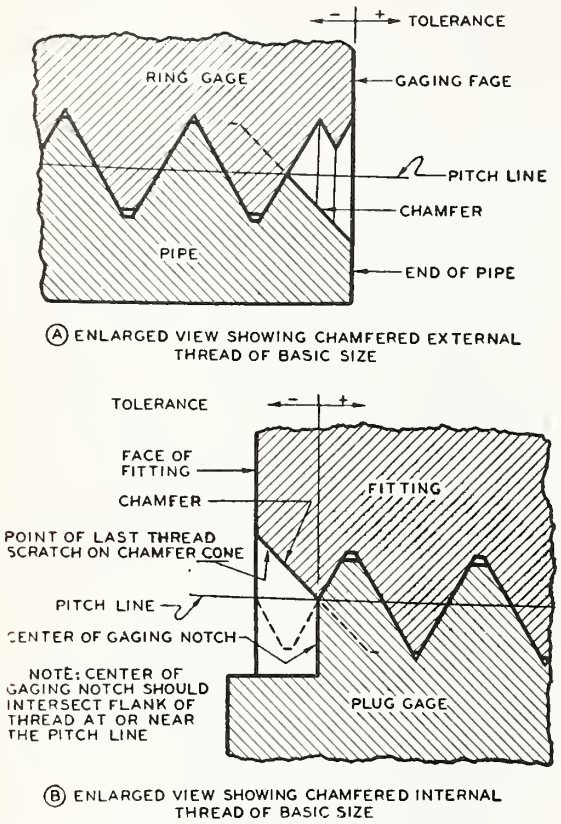
within the permissible tolerance when the gaging face of the working ring gage is not more than 1 turn, large or small, from being flush with the end of the thread, as indicated in figure 27. When using inspection gages, a tolerance of plus or minus 1½ turns shall be permitted, after allowing for any variation in the inspection gage from basic dimensions.

(b) *Gaging internal taper pipe threads.*—The plug gage is screwed up tight by hand into the internal thread of the product. The thread is within the permissible tolerance when the gaging notch of the working plug gage is not more than 1 turn, large or small, from being flush with the end of the thread, as indicated figure 28. When using inspection gages, a tolerance of plus or minus 1½ turns shall be permitted, after allowing for any variation in the inspection gage from basic dimensions.

(c) *Gaging of chamfered thread.*—When the internal thread is chamfered, the notch should be flush with the bottom of the chamfer, which shall be considered as being the intersection of the chamfer cone and the pitch cone of the thread. (See view *B*, fig. 29.) In a majority of cases this depth is equal to one-half thread or approximately $p/2$ from the face of the valve or fitting.

(d) *Direct measurement.*—Taper pipe threads on the product are regularly checked

only by gaging, but where a more exact check may be needed on threaded pipe made of steel, wrought iron, or brass, and on other threaded products of steel, direct measurement of threads may be specified.



Ⓐ ENLARGED VIEW SHOWING CHAMFERED EXTERNAL THREAD OF BASIC SIZE

Ⓑ ENLARGED VIEW SHOWING CHAMFERED INTERNAL THREAD OF BASIC SIZE

FIGURE 29.—*Gaging of chamfered threads.*

NOTE —The chamfer illustrated is at 45° angle and is ½ pitch in depth. However, these details are not requirements and are given only for information on the illustration shown. The chamfered portion of thread, and the full chamfer cone, are indicated by dotted lines.

4. MARKING OF GAGES.—Each gage shall be marked so as to clearly indicate the normal size of pipe, number of threads per inch, and the proper symbol to identify the thread form.

N = National.
P = Pipe.
T = Taper.
C = Coupling.
S = Straight.
F = Fuel Oil.
M = Mechanical.
L = Locknut.
H = Hose Coupling.
R = Railing Fittings.

Example: ⅜"—18NPT.

Symbols recommended for use on gages:

NPT = American National taper pipe threads.

NPSC = American National straight pipe thread in pipe couplings.

NPTF = American National taper pipe thread for Dryseal pressure-tight joints.

NPSF = American National straight pipe thread for Dryseal pressure-tight joints.

NPSM = American National straight pipe thread for mechanical joints.

NPSL = American straight pipe thread for locknuts and locknut pipe threads.

NPSH = American National straight pipe threads for hose couplings and nipples.

NPTR = American National taper pipe thread for railing fittings.

TABLE 62.—*Basic dimensions of taper thread plug and ring gages for American National taper pipe threads*

Nominal pipe size	Threads per inch, n	Pitch, p	Major diameters of plug gages[1]			Pitch diameters of plug and ring gages			Minor diameters of ring gages[1]			Increase in diameter per thread, $\frac{0.0625}{n}$	Thickness of thin ring, L_1	Thickness of full ring, L_2
			At small end, $E_0 + \frac{0.666025}{n}$	At gaging notch, $E_1 + \frac{0.666025}{n}$	At large end, full ring, $E_2 + \frac{0.666025}{n}$	At small end, E_0	At gaging notch, E_1	At large end, full ring, E_2	At small end, $E_0 - \frac{0.666025}{n}$	At gaging notch, $E_1 - \frac{0.666025}{n}$	At large end, full ring, $E_2 - \frac{0.666025}{n}$			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Inch	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inch*	*Inches*	*Inches*
1/16	27	0.03704	0.29585	0.30585	0.31217	0.27118	0.28118	0.28750	0.24651	0.25651	0.26283	0.00231	0.160	0.26111
1/8	27	.03704	.38818	.39943	.40467	.36351	.37476	.38000	.33884	.35009	.35533	.00231	.180	.26385
1/4	18	.05556	.51439	.52689	.53950	.47739	.48989	.50250	.44039	.45289	.46550	.00347	.200	.40178
3/8	18	.05556	.64902	.66402	.67450	.61201	.62701	.63750	.57501	.59001	.60050	.00347	.240	.40778
1/2	14	.07143	.80600	.82600	.83936	.75843	.77843	.79179	.71086	.73086	.74421	.00446	.320	.53371
3/4	14	.07143	1.01525	1.03644	1.04936	.96768	.98887	1.00179	.92011	.94129	.95421	.00446	.339	.54571
1	11 1/2	.08696	1.27155	1.29655	1.31422	1.21363	1.23863	1.25630	1.15571	1.18072	1.19839	.00543	.400	.68278
1 1/4	11 1/2	.08696	1.61505	1.64130	1.65922	1.55713	1.58338	1.60130	1.49921	1.52547	1.54339	.00543	.420	.70678
1 1/2	11 1/2	.08696	1.85400	1.88025	1.89922	1.79609	1.82234	1.84130	1.73817	1.76442	1.78339	.00543	.420	.72348
2	11 1/2	.08696	2.32694	2.35419	2.37422	2.26902	2.29627	2.31630	2.21111	2.23836	2.25839	.00543	.436	.75652
2 1/2	8	.12500	2.80278	2.84541	2.87388	2.71953	2.76216	2.79062	2.63628	2.67890	2.70737	.00781	.682	1.13750
3	8	.12500	3.42388	3.47175	3.49888	3.34062	3.38850	3.41562	3.25737	3.30525	3.33237	.00781	.766	1.20000
3 1/2	8	.12500	3.92075	3.97207	3.99888	3.83750	3.88881	3.91562	3.75425	3.80556	3.83237	.00781	.821	1.25000
4	8	.12500	4.41763	4.47038	4.49888	4.33438	4.38712	4.41562	4.25112	4.30387	4.33237	.00781	.844	1.30000
5	8	.12500	5.47398	5.53255	5.56188	5.39073	5.44929	5.47862	5.30748	5.36604	5.39537	.00781	.937	1.40630
6	8	.12500	6.52935	6.58922	6.62388	6.44609	6.50597	6.54062	6.36284	6.42272	6.45737	.00781	.958	1.51250
8	8	.12500	8.51685	8.58328	8.62388	8.43359	8.50003	8.54062	8.35034	8.41678	8.45737	.00781	1.063	1.71250
10	8	.12500	10.62857	10.70419	10.74888	10.54531	10.62094	10.66562	10.46206	10.53768	10.58237	.00781	1.210	1.92500
12	8	.12500	12.61607	12.70107	12.74888	12.53281	12.61781	12.66562	12.44956	12.53456	12.58237	.00781	1.360	2.12500
14 OD	8	.12500	13.85825	13.95588	13.99888	13.77500	13.87262	13.91562	13.69175	13.78937	13.83237	.00781	1.562	2.25000
16 OD	8	.12500	15.84575	15.95900	15.99888	15.76250	15.87575	15.91562	15.67925	15.79250	15.83237	.00781	1.812	2.45000
18 OD	8	.12500	17.83325	17.95825	17.99888	17.75000	17.87500	17.91562	17.66675	17.79175	17.83237	.00781	2.000	2.65000
20 OD	8	.12500	19.82075	19.95357	19.99888	19.73750	19.87031	19.91562	19.65425	19.78706	19.83237	.00781	2.125	2.85000
24 OD	8	.12500	23.79575	23.94419	23.99888	23.71250	23.86094	23.91562	23.62925	23.77768	23.83237	.00781	2.375	3.25000

[1] These dimensions are based on a crest truncation of $0.1p$ for pipe thread gages, which insures bearing of the gage on the sides of the thread, when cut with a slightly dull tool, instead of at the roots of the thread.

TABLE 63.—*Tolerances for American National reference, inspection, and working taper pipe thread plug and ring gages*

Nominal pipe size	Threads per inch	Tolerance on pitch diameter[1]	Tolerance on lead[2 4]		Tolerance on half angle[3]		Tolerance on taper[4 5]		Tolerance on major diameter[6]	Tolerance on minor diameter[7]	Total cumulative tolerances on pitch diameter		Stand-off between plug and ring gages at gaging notch	
			Plugs	Rings	Plugs	Rings	Plugs	Rings	Plugs	Rings	Plugs	Rings	Dimensions at opposite extreme tolerance limits[8]	Dimensions midway between opposite tolerance limits[9]
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Inches		*Inch* ±	*Inch*	*Inch*	*Min* ±	*Min* ±	*Inch* +	*Inch* −	*Inch* −	*Inch* +	*Inch*	*Inch*	*Inch*	*Inch*
1/16	27	0.0002	0.0002	0.0003	15	20	0.0003	0.0006	0.0004	0.0004	0.00080	0.00118	0.032	0.008
1/8	27	.0002	.0002	.0003	15	20	.0003	.0006	.0004	.0004	.00080	.00118	.032	.008
1/4	18	.0002	.0002	.0003	15	20	.0004	.0007	.0006	.0006	.00092	.00134	.036	.010
3/8	18	.0002	.0002	.0003	15	20	.0004	.0007	.0006	.0006	.00092	.00134	.036	.010
1/2	14	.0003	.0002	.0003	10	15	.0006	.0009	.0010	.0010	.00097	.00142	.038	.011
3/4	14	.0003	.0002	.0003	10	15	.0006	.0009	.0010	.0010	.00097	.00142	.038	.011
1	11 1/2	.0003	.0003	.0004	10	15	.0008	.0012	.0010	.0010	.00121	.00170	.047	.013
1 1/4	11 1/2	.0003	.0003	.0004	10	15	.0008	.0012	.0010	.0010	.00121	.00170	.047	.013
1 1/2	11 1/2	.0003	.0003	.0004	10	15	.0008	.0012	.0010	.0010	.00121	.00170	.047	.013
2	11 1/2	.0003	.0003	.0004	10	15	.0008	.0012	.0010	.0010	.00121	.00170	.047	.013
2 1/2	8	.0005	.0004	.0005	7	10	.0010	.0014	.0016	.0016	.00158	.00211	.059	.016
3	8	.0005	.0004	.0005	7	10	.0010	.0014	.0016	.0016	.00158	.00211	.059	.016
3 1/2	8	.0005	.0004	.0005	7	10	.0010	.0014	.0016	.0016	.00158	.00211	.059	.016
4	8	.0005	.0004	.0005	7	10	.0010	.0014	.0016	.0016	.00158	.00211	.059	.016
5	8	.0005	.0004	.0005	7	10	.0010	.0014	.0016	.0016	.00158	.00211	.059	.016
6	8	.0005	.0004	.0005	7	10	.0010	.0014	.0016	.0016	.00158	.00211	.059	.016
8	8	.0005	.0004	.0005	7	10	.0010	.0014	.0020	.0020	.00158	.00211	.059	.016
10	8	.0005	.0004	.0005	7	10	.0010	.0014	.0020	.0020	.00158	.00211	.059	.016
12	8	.0005	.0004	.0005	7	10	.0010	.0014	.0020	.0020	.00158	.00211	.059	.016
14 OD	8	.0008	.0005	.0006	7	10	.0010	.0014	.0030	.0030	.00206	.00271	.076	.020
16 OD	8	.0008	.0005	.0006	7	10	.0010	.0014	.0030	.0030	.00206	.00271	.076	.020
18 OD	8	.0008	.0005	.0006	7	10	.0010	.0014	.0030	.0030	.00206	.00271	.076	.020
20 OD	8	.0008	.0005	.0006	7	10	.0010	.0014	.0030	.0030	.00206	.00271	.076	.020
24 OD	8	.0008	.0005	.0006	7	10	.0010	.0014	.0030	.0030	.00206	.00271	.076	.020

[1] To be measured at the gaging notch of plug gage.

[2] Allowable variation in lead between any two threads in L_1 length of gage (figs. 24 and 26.)

[3] In solving for the correction in diameter for angle errors, the average error in half angle for the two sides of thread regardless of their signs should be taken.

[4] The lead and taper on plug and ring gages shall be measured along the pitch line, omitting the imperfect threads at each end.

[5] Allowable variation in taper, in L_1 length of gage (figs. 24 and 26.)

[6] Tolerance on major diameter of plug gage at gaging notch.

[7] Tolerance on minor diameter of ring gage at large end.

[8] Maximum possible interchange stand-off, any ring against any plug other than its master plug, may occur when taper errors are zero and all other dimensions are at opposite extreme tolerance limits.

[9] Interchange stand-off, any ring against any plug other than its master plug, may occur when all dimensions including taper are midway between opposite tolerance limits.

NOTE.—The large end of the ring gage shall be flush with the gaging notch of its master plug gage when assembled hand tight within ±0.002 in. for sizes 1/16 to 2 in. inclusive, within ±0.003 in. for sizes 2 1/2 to 12 in., inclusive, and within ±0.005 in. for sizes 14 in. and larger.

The tolerances for the length L_1 from small end to gaging notch of the plug gage (figs. 24 and 26) shall be +0.000 and −0.001 for sizes 1/16 to 2 in., inclusive, and +0.000 and −0.002 for sizes 2 1/2 in. and larger.

The tolerances for the over-all thread length L_2 of the plug gage (figs. 24 and 26) shall be +0.005 and −0.000 for sizes 1/16 in. to 2 in., inclusive, and +0.010 and −0.000 for sizes 2 1/2 in. and larger.

Tolerances for the thickness L_1 of the ring gage (figs. 24 and 26) shall be +0.001 and −0.000 for sizes 1/16 to 2 in., inclusive, and +0.002 and −0.000 for sizes 2 1/2 in. and larger.

TABLE 64.—*Corrections in diameter of tools and gages for errors in half angle,*[1] *American National taper pipe threads*

Error in half angle of thread in minutes, a'	Correction in diameter, $E'' = \frac{1.53812}{n} \times \tan a'$				
	8 threads per inch	11½ threads per inch	14 threads per inch	18 threads per inch	27 threads per inch
1	2	3	4	5	6
	Inch	*Inch*	*Inch*	*Inch*	*Inch*
1	0.00006	0.00004	0.00003	0.00002	0.00002
2	.00011	.00008	.00006	.00005	.00003
3	.00017	.00012	.00010	.00007	.00005
4	.00022	.00016	.00013	.00010	.00007
5	.00028	.00019	.00016	.00012	.00008
6	.00034	.00023	.00019	.00015	.00010
7	.00039	.00027	.00022	.00017	.00012
8	.00045	.00031	.00026	.00020	.00013
9	.00050	.00035	.00029	.00022	.00015
10	.00056	.00039	.00032	.00025	.00017
11	.00062	.00043	.00035	.00027	.00018
12	.00067	.00047	.00038	.00030	.00020
13	.00073	.00051	.00042	.00032	.00022
14	.00078	.00054	.00045	.00035	.00023
15	.00084	.00058	.00048	.00037	.00025
16	.00089	.00062	.00051	.00040	.00027
17	.00095	.00066	.00054	.00042	.00028
18	.00101	.00070	.00058	.00045	.00030
19	.00106	.00074	.00061	.00047	.00031
20	.00112	.00078	.00064	.00050	.00033
21	.00117	.00082	.00067	.00052	.00035
22	.00123	.00086	.00070	.00055	.00036
23	.00129	.00089	.00074	.00057	.00038
24	.00134	.00093	.00077	.00060	.00040
25	.00140	.00097	.00080	.00062	.00041
26	.00145	.00101	.00083	.00065	.00043
27	.00151	.00105	.00086	.00067	.00045
28	.00157	.00109	.00089	.00070	.00046
29	.00162	.00113	.00093	.00072	.00048
30	.00168	.00117	.00096	.00075	.00050
45	.00252	.00175	.00144	.00112	.00075
60	.00336	.00233	.00192	.00149	.00099

[1]See appendix 1, p. 223.

TABLE 65.—*Corrections in diameter of tools and gages for errors in lead, 60° threads*[1]

Error in lead in inches, p'	Correction in diameter, $E' = 1.732\ p'$									
	0.00000	0.00001	0.00002	0.00003	0.00004	0.00005	0.00006	0.00007	0.00008	0.00009
1	2	3	4	5	6	7	8	9	10	11
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
0.00000	0.00000	0.00002	0.00003	0.00005	0.00007	0.00009	0.00010	0.00012	0.00014	0.00016
.00010	.00017	.00019	.00021	.00023	.00024	.00026	.00028	.00029	.00031	.00033
.00020	.00035	.00036	.00038	.00040	.00042	.00043	.00045	.00047	.00048	.00050
.00030	.00052	.00054	.00055	.00057	.00059	.00061	.00062	.00064	.00066	.00068
.00040	.00069	.00071	.00073	.00074	.00076	.00078	.00080	.00081	.00083	.00085
.00050	.00087	.00088	.00090	.00092	.00094	.00095	.00097	.00099	.00100	.00102
.00060	.00104	.00106	.00107	.00109	.00111	.00113	.00114	.00116	.00118	.00120
.00070	.00121	.00123	.00125	.00126	.00128	.00130	.00132	.00133	.00135	.00137
.00080	.00139	.00140	.00142	.00144	.00145	.00147	.00149	.00151	.00152	.00154
.00090	.00156	.00158	.00159	.00161	.00163	.00165	.00166	.00168	.00170	.00171
.00100	.00173	.00175	.00177	.00178	.00180	.00182	.00184	.00185	.00187	.00189
.00110	.00191	.00192	.00194	.00196	.00197	.00199	.00201	.00203	.00204	.00206
.00120	.00208	.00210	.00211	.00213	.00215	.00217	.00218	.00220	.00222	.00223
.00130	.00225	.00227	.00229	.00230	.00232	.00234	.00236	.00237	.00239	.00241
.00140	.00242	.00244	.00246	.00248	.00249	.00251	.00253	.00255	.00256	.00258
.00150	.00260	.00262	.00263	.00265	.00267	.00268	.00270	.00272	.00274	.00275
.00160	.00277	.00279	.00281	.00282	.00284	.00286	.00288	.00289	.00291	.00293
.00170	.00294	.00296	.00298	.00300	.00301	.00303	.00305	.00307	.00308	.00310
.00180	.00312	.00313	.00315	.00317	.00319	.00320	.00322	.00324	.00326	.00327
.00190	.00329	.00331	.00333	.00334	.00336	.00338	.00339	.00341	.00343	.00345
.00200	.00346	.00348	.00350	.00352	.00353	.00355	.00357	.00359	.00360	.00362

[1]See appendix 1, p. 222.

2. SPECIFICATIONS FOR MODIFIED TAPER PIPE THREADS

(a) DRYSEAL PRESSURE-TIGHT JOINTS

The pipe thread joints which are to be made up without lubricant or sealer consist of external and internal screw threads having the same general form and dimensions as those of the American National regular taper pipe thread given in table 59. However, for this type of joint the thread form is truncated to the amount given in table 67. There is no clearance permitted between the external and internal threads. When the joint is completely made up, the flanks and flats on the fitting and the pipe are supposed to meet, thus producing a metal to metal joint with interference at the crest and root of the mating parts. It is this feature of the thread which eliminates the need for a sealer. When a lubricant is employed it serves to prevent galling during the make-up of the joint with power.

The sketches at the head of table 67 give a sectional view of this modified thread form. When the crests and roots of commercially manufactured product are examined closely, they will be found to be slightly rounded at the edges. It is intended that the pipe threads of this form on products shall be acceptable when the entire crests and roots lie within the limits set up in table 67.

The principal uses for this thread during its development were for refrigerant, marine, automotive and aircraft fuel and oil line fittings, drain and filler plugs, ordnance gas shells, chemical bombs, etc.

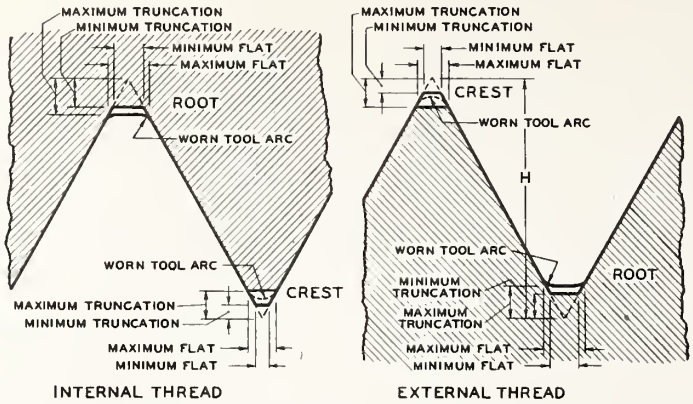
TABLE 66.—*Tolerances on taper, lead, and angle of Dryseal American National taper pipe threads on pipe and fittings*

Nominal pipe size	Threads per inch	Taper on pitch line, per foot		Lead in length of effective threads [1]	60° angle of threads
		Max	Min		
1	2	3	4	5	6
Inches		*Inch*	*Inch*	*Inch* ±	*Degrees* ±
1/16, 1/8.....	27	25/32	23/32	0.0010	1½
1/4, 3/8.....	18	25/32	23/32	.0015	1½
1/2, 3/4.....	14	25/32	23/32	.0020	1½
1, 1¼, 1½, 2....	11½	25/32	23/32	.0025	1½
2½ and larger....	8	25/32	23/32	.0040	1½

[1] For sizes 2½ in. and larger, the tolerance on lead shall not exceed 0.003 in. in any inch of thread length. Sizes 1, 1¼, 1½, and 2 in., with threads of special length greater than 1 in., shall be subject to same lead tolerance specified for the 2½-in. size.

NOTE.—For tolerances on depth of thread, see table 67, and for tolerances on pitch diameter, see par. (c) 1, p. 118.

TABLE 67.—*Limits on crest and root of Dryseal American National external and internal taper pipe threads;*[1] *(pressure-tight joints without lubricant or sealer)*



Threads per inch	Depth of sharp V thread, H	Truncation				Tolerance on truncation	Equivalent width of flat[2]				Tolerance on equivalent width of flat
		Minimum		Maximum			Minimum		Maximum		
1	2	3	4	5	6	7	8	9	10	11	12
	Inches	*Formula*	*Inches*	*Formula*	*Inches*	*Inches*	*Formula*	*Inches*	*Formula*	*Inches*	*Inches*
27 crest	0.03208	0.017p	0.0017	0.091p	0.0035	0.0018	0.054p	0.0020	0.108p	0.0040	0.0020
27 root		.094p	.0035	.117p	.0043	.0008	.108p	.0040	.135p	.0050	.0010
18 crest	.01811	.017p	.0026	.078p	.0043	.0017	.054p	.0030	.090p	.0050	.0020
18 root		.078p	.0043	.094p	.0052	.0009	.090p	.0050	.108p	.0060	.0010
14 crest	.06186	.036p	.0026	.060p	.0043	.0017	.042p	.0030	.070p	.0050	.0020
14 root		.060p	.0043	.073p	.0052	.0009	.070p	.0050	.084p	.0060	.0010
11½ crest	.07531	.040p	.0035	.060p	.0052	.0017	.046p	.0040	.069p	.0060	.0020
11½ root		.060p	.0052	.080p	.0069	.0017	.069p	.0060	.092p	.0080	.0020
8 crest	.10825	.042p	.0052	.055p	.0069	.0017	.048p	.0060	.064p	.0080	.0020
8 root		.055p	.0069	.069p	.0087	.0018	.064p	.0080	.080p	.0100	.0020

[1] Although these threads are designed for use without a lubricant or sealer, its use may be found to be desirable.

[2] The major diameter of plug gages and the minor diameter of ring gages used for gaging Dryseal threads shall be truncated 0.20p for 27 threads per inch, and 0.15p for 18, 14, 11½, and 8 threads per inch.

NOTE.—Dimensions are specified to four and five decimal places. While this implies a greater degree of precision than is ordinarily attained, these dimensions are so expressed for the purpose of eliminating errors in computations.

(b) RAILING JOINTS

Railing joints require a rigid mechanical thread joint with external and internal taper threads.

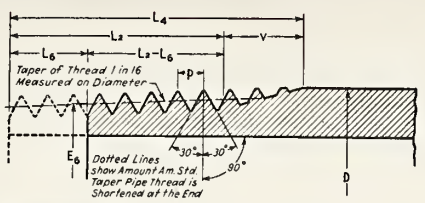
The external thread is basically the same as the American National taper pipe thread, except that it is shortened to permit the use of the larger end of the pipe thread. (See the figure over table 68.) The dimensions of these external and internal threads are shown in table 68. A recess in the fitting provides a covering for the last scratch or imperfect threads on the pipe.

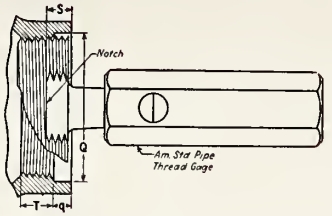
The form of thread is the same as the form of the American National taper pipe thread shown in figure 22.

The gaging of these threads is specified in table 68.

The symbol NPTR should be used on tools and gages to indicate the American National taper pipe thread for railing joints.

TABLE 68.—*Dimensions of external and internal taper pipe threads for railing joints, (mechanical joints)*





Nominal pipe size	Outside diameter of pipe, D	Threads per inch	Depth of thread	Pitch diameter at end of external thread, E_6	Shortening of Am. Nat. taper pipe thread, L_6		Length of effective thread, L_2-L_6		Total length of external thread, max, L_4-L_6		Imperfect threads due to lead of die, max, V		Depth of recess in fitting, q	Diameter of recess in fitting, Q	Thread length, T	Distance gage[1] notch comes below face of fitting, S	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Inches	*Inches*		*Inch*	*Inches*	*Inch*	*Threads*	*Inch*	*Threads*	*Inches*	*Threads*	*Inch*	*Threads*	*Inch*	*Inches*	*Inch*	*Inch*	*Threads*
½.....	0.840	14	0.0571	0.7718	0.214	3	0.320	4.47	0.499	6.98	0.179	2½	0.18	0.86	0.25	0.286	4
¾.....	1.050	14	.0571	.9811	.214	3	.332	4.64	.510	7.15	.179	2½	.18	1.07	.25	.286	4
1.....	1.315	11½	.0696	1.2299	.261	3	.422	4.85	.639	7.35	.217	2½	.22	1.34	.30	.348	4
1¼.....	1.660	11½	.0696	1.5734	.261	3	.446	5.13	.707	8.13	.261	3	.26	1.68	.39	.348	4
1½.....	1.900	11½	.0696	1.8124	.261	3	.463	5.32	.724	8.33	.261	3	.26	1.92	.43	.348	4
2.....	2.375	11½	.0696	2.2853	.261	3	.496	5.70	.757	8.70	.261	3	.26	2.40	.43	.348	4
2½.....	2.875	8	.1000	2.7508	.500	4	.638	5.10	1.013	8.10	.375	3	.38	2.90	.63	.625	5
3.....	3.500	8	.1000	3.3719	.500	4	.700	5.60	1.075	8.60	.375	3	.38	3.53	.63	.625	5
3½.....	4.000	8	.1000	3.8688	.500	4	.750	6.00	1.125	9.00	.375	3	.38	4.04	.63	.625	5
4.....	4.500	8	.1000	4.3656	.500	4	.800	6.40	1.175	9.40	.375	3	.38	4.54	.63	.625	5

[1] American National taper pipe thread plug gage.

NOTE.—These dimensions agree with those developed by the Manufacturers Standardization Society of the Valve and Fittings Industry. Thread lengths are specified to 3 decimal places for convenience.

(c) THREADING OF PIPE FOR AMERICAN STANDARD THREADED STEEL FLANGES

The length of the effective external taper thread of the American National pipe thread provides a sufficient number of threads on the pipe to insure a satisfactory joint with the ordinary weight of fitting or flange. The American Standard steel flanges for high pressure-temperature service (ASA B16e-1939) calls for thread lengths in the flanges in proportion to the thickness of the flange. This means that the thread lengths in the flanges intended for higher pressures in a given size are longer than the thread lengths in the flanges intended for the lower pressures.

Table 69 provides for a length of effective thread on pipe for sizes and weights of flanges where the regular American National length of effective thread is too short to bring the end of the pipe reasonably close to the face of the flange when both parts are assembled by power. As the threads in all flanges as well as on the pipe are gaged with a tolerance of one thread large and one thread small there will naturally be some difference in distance between the end of the pipe and face of the flange in the various assemblies for the different sizes and weights of flanges.

In the following table the additional number of threads are added to the small end of the standard pipe thread and the pitch diameter at the end of the external thread is, therefore, smaller than that of the regular standard pipe. In other words, the small end of the ring gage will pass over the end of the pipe the number of turns or the length in inches equal to the values given in table 69.

TABLE 69.—*Projection of threaded end through ring gage, steel flanges*

Nominal pipe size	150, 300 lb	400 lb	600 lb		900 lb		1,500 lb		2,500 lb	
	Number of turns	Number of turns	Number of turns	Inches	Number of turns	Inches	Number of turns	Inches	Number of turns	Inches
½	(1)	.....	(1)	(1)	.....	.....	3½	0.25	7	0.50
¾	(1)	.....	(1)	(1)	.....	.....	5	.36	7	.50
1	(1)	.....	(1)	(1)	.....	.....	5	.43	7½	.65
1¼	(1)	.....	(1)	(1)	.....	.....	5	.43	7½	.65
1½	(1)	.....	(1)	(1)	.....	.....	5	.43	7½	.65
2	(1)	.....	(1)	(1)	.....	.....	5	.43	7½	.65
2½	(1)	.....	(1)	(1)	.....	.....	5	.625	8	1.00
3	(1)	.....	1	0.125	3	0.375	6	.75	10	1.25
3½	(1)	.....	1	.125	.....	.....	.....	.....	.....	.....
4	(1)	(1)	1½	.187	3½	.437	6½	.81	10½	1.31
5	(1)	(1)	1½	.187	3½	.437	6½	.81	10½	1.31
6	(1)	(1)	1½	.187	3½	.437	7½	.94	11½	1.44
8	(1)	(1)	2	.250	4	.500	8	1.00	14	1.75
10	(1)	(1)	3	.375	5	.625	9	1.125	16	2.00
12	(1)	(1)	3	.375	5	.625	10	1.250	19	2.375
14 OD	(1)	(1)	3	.375	6	.750	.....	.....	.....	.....
16 OD	(1)	(1)	3	.375	6	.750	.....	.....	.....	.....
18 OD	(1)	(1)	3	.375	6	.750	.....	.....	.....	.....
20 OD	(1)	(1)	3	.375	6	.750	.....	.....	.....	.....
24 OD	(1)	(1)	3	.375	6	.750	.....	.....	.....	.....

[1]Regular American National pipe thread is used for this size.

3. SPECIFICATIONS FOR STRAIGHT PIPE THREADS

While external and internal taper pipe threads are recommended for pipe joints in practically every service, there are certain types of joints where straight pipe threads are used to advantage.

(a) THREAD SPECIFICATIONS

1. FORM OF THREAD.—The pitch, angle, and depth of thread are the same as the corresponding dimensions of the American National taper pipe thread. (See exceptions in pars. (b)1(c), (b)2(a), and (b)2(c) below.)

2. Diameter of Thread.—The basic pitch diameter for both the external and internal straight pipe thread is equal to the pitch diameter of the American National taper pipe thread at the gaging notch, (dimension E_1, table 59), and is the same as the large end of the internal taper pipe thread. The variations from this diameter are covered in par. (c)3 below.

(b) TYPES OF JOINTS

Five types of straight pipe thread joints are covered by this standard, of which two are pressure-tight and three are mechanical. These five types of joints are as follows: (For identifying symbols, see p. 126.)

Type 1. Pressure-tight joints, with lubricant or sealer for pipe couplings, tables 59 and 70, taper external, straight internal.

Type 2. [21]Pressure-tight joints, without lubricant or sealer for automotive, fuel and oil line fittings, drain plugs and filler plugs, etc., tables 67 and 71, taper external, straight internal.

Type 3. Free-fitting mechanical joints for fixtures, table 72, both external and internal.

Type 4. Loose-fitting mechanical joints with locknuts, table 73, both external and internal.

Type 5. Loose-fitting mechanical joints for hose couplings, table 77.

1. Pressure-Tight Joints With Internal Straight Pipe Threads.—*(a) General.*—Pressure-tight joints are sometimes made with internal straight pipe threads and external taper pipe threads. There are two classes of internal straight pipe thread used. In both of these classes one or both of the members are considered to be sufficiently ductile to adjust themselves to each other. The resulting joints are recommended for comparatively low pressures only.

[21] Although these threads are designed for use without lubricant or sealer, its use may be found to be desirable.

(b) Pipe couplings.—The dimensions of these straight internal screw threads for pipe couplings are given in table 70. This thread is designed for use with lubricant or sealer.

TABLE 70.—*Dimensions of American National internal straight pipe threads in pipe couplings (pressure-tight joints with lubricant or sealer)*

Nominal pipe size	Threads per inch	Pitch diameter[1]		Minor[4] diameter
		Maximum[2]	Minimum[3]	Minimum
1	2	3	4	5
Inches	*Inches*	*Inches*	*Inches*	*Inches*
⅛	27	0.3782	0.3713	0.342
¼	18	.4951	.4847	.440
⅜	18	.6322	.6218	.577
½	14	.7851	.7717	.715
¾	14	.9956	.9822	.925
1	11½	1.2468	1.2305	1.161
1¼	11½	1.5915	1.5752	1.506
1½	11½	1.8305	1.8142	1.745
2	11½	2.3044	2.2881	2.219
2½	8	2.7739	2.7504	2.650
3	8	3.4002	3.3768	3.277
3½	8	3.9005	3.8771	3.777
4	8	4.3988	4.3754	4.275

[1] Attention is called to the fact that the actual pitch diameter of the straight tapped hole will be slightly smaller than the values given when gaged with a taper plug gage, as specified below under (c), p. 138.

[2] Column 3 is the same as the pitch diameter at the end of internal thread E_1, table 59, increased by 1½ turns.

[3] Column 4 is equal to column 3, reduced by 3 turns.

[4] As the American National pipe thread form is maintained the major and minor diameters of the internal thread vary with the pitch diameter.

(c) Automotive, fuel and oil line fittings, drain plugs, filler plugs, etc.—Automotive fuel and oil line fittings are generally attached by an external Dryseal taper pipe thread and a Dryseal internal straight pipe thread without lubricant or sealer. The dimensions are given in tables 59, 67, and 71.

(d) Automotive and aircraft hydraulic line fittings, drain plugs, filler plugs, etc.—Automotive and aircraft hydraulic line fittings, drain plugs, filler plugs, etc., are joined by two straight machine screw threads (external and internal) drawn to a shoulder. The dimensions are given in section IV.

TABLE 71.—*Dimensions of Dryseal internal straight pipe threads (pressure-tight joints without lubricant or sealer)*

Nominal pipe size	Threads per inch	Pitch diameter[1]		Minor[2] diameter
		Maximum	Minimum	Minimum
1	2	3	4	5
Inch		*Inches*	*Inches*	*Inches*
1/16	27	0.2812	0.2777	0.2491
1/8	27	.3736	.3701	.3415
1/4	18	.4916	.4864	.4435
3/8	18	.6270	.6218	.5789
1/2	14	.7784	.7717	.7150
3/4	14	.9889	.9822	.9255
1	11 1/2	1.2386	1.2305	1.1621

[1] Attention is called to the fact that the actual pitch diameter of the straight tapped hole will be slightly smaller than the values given when gaged with a taper plug gage, as specified below under (c), p. 138.

[2] As the Dryseal pipe thread form is maintained, the major and minor diameters of the internal thread vary with the pitch diameter.

2. MECHANICAL JOINTS.—*(a) Free-fitting mechanical joints.*—Standard iron, steel, and brass pipe are often used for special applications where there are no internal pressures. Where straight thread joints are required for mechanical assemblies, straight pipe threads are often found more suited or convenient.

The dimensions of these threads, as given in table 72, are for pipe thread connections where the parts are assembled in the shop and where reasonably close fit of the mating parts is desired. Major and minor diameters have been calculated to provide no interference at crest and root when product is gaged with gages made in accordance with par. (c)4, below.

TABLE 72.—*Dimensions of American National external and internal straight pipe threads for mechanical joints (free fitting)*

Nominal pipe size	Threads per inch	Depth of thread, $h = 0.666025p$	External thread[1]					Internal thread				
			Major diameter		Pitch diameter		Minor diameter, maximum	Minor diameter		Pitch diameter		Major diameter, minimum
			Max	Min	Max[2]	Min		Min	Max	Min[2]	Max	
1	2	3	4	5	6	7	8	9	10	11	12	13
		Inch	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1/8	27	0.02467	0.3995	0.3926	0.3748	0.3713	0.3501	0.3501	0.3570	0.3748	0.3783	0.3995
1/4	18	.03700	.5269	.5165	.4899	.4847	.4529	.4529	.4633	.4899	.4951	.5269
3/8	18	.03700	.6640	.6536	.6270	.6218	.5900	.5900	.6004	.6270	.6322	.6640
1/2	14	.04757	.8260	.8126	.7784	.7717	.7308	.7308	.7442	.7784	.7851	.8260
3/4	14	.04757	1.0365	1.0231	.9889	.9822	.9413	.9413	.9547	.9889	.9956	1.0365
1	11 1/2	.05792	1.2965	1.2802	1.2386	1.2305	1.1807	1.1807	1.1970	1.2386	1.2468	1.2965
1 1/4	11 1/2	.05792	1.6413	1.6250	1.5834	1.5753	1.5255	1.5255	1.5418	1.5834	1.5916	1.6413
1 1/2	11 1/2	.05792	1.8802	1.8639	1.8223	1.8142	1.7644	1.7644	1.7807	1.8223	1.8305	1.8802
2	11 1/2	.05792	2.3542	2.3379	2.2963	2.2882	2.2384	2.2384	2.2547	2.2963	2.3044	2.3542
2 1/2	8	.08325	2.8455	2.8221	2.7622	2.7505	2.6789	2.6789	2.7023	2.7622	2.7739	2.8455
3	8	.08325	3.4718	3.4484	3.3885	3.3768	3.3052	3.3052	3.3286	3.3885	3.4002	3.4718
3 1/2	8	.08325	3.9721	3.9487	3.8888	3.8771	3.8055	3.8055	3.8289	3.8888	3.9005	3.9721
4	8	.08325	4.4704	4.4470	4.3871	4.3754	4.3038	4.3038	4.3272	4.3871	4.3988	4.4704
5	8	.08325	5.5326	5.5092	5.4493	5.4376	5.3660	5.3660	5.3894	5.4493	5.4610	5.5326
6	8	.08325	6.5893	6.5659	6.5060	6.4943	6.4227	6.4227	6.4461	6.5060	6.5177	6.5893

[1] For the convenience of those who might desire to use this type of straight pipe thread with an allowance, the following allowances, to be subtracted from the diameter of the external thread, are suggested:

Threads per inch	Allowance
	Inch
27	0.0025
18	.0030
14	.0040
11 1/2	.0050
8	.0070

[2] Columns 6 and 11 are the same as the pitch diameter at the end of internal thread, E_1, basic. (See table 59, col. 8.)

(b) Locknut Threads.—The American National external locknut thread is designed to produce a pipe thread having the largest diameter that it is possible to cut on standard pipe. Ordinarily, straight internal threads are used with these straight external threads, providing a loose fit. One application of this locknut thread is the seal joint common in the tank nipple thread connection shown in figure 30. The dimensions of these threads are given in table 73.

It will be noted that the maximum major diameter of the external thread is slightly greater than the nominal outside diameter of the pipe. The normal manufacturers' variation in pipe diameter provides for this increase.

TABLE 73.—*Dimensions, external and internal straight pipe threads for locknut connections (loose-fitting mechanical joints)*

Nominal pipe size	Threads per inch	External threads					Internal threads				
		Major diameter		Pitch diameter		Minor diameter, maximum	Minor diameter		Pitch diameter		Major diameter, minimum
		Maximum[1]	Minimum	Maximum[2]	Minimum[3]		Minimum	Maximum	Minimum[4]	Maximum[5]	
1	2	3	4	5	6	7	8	9	10	11	12
		Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1/8	27	0.4087	0.4018	0.3840	0.3805	0.3593	0.3616	0.3685	0.3863	0.3898	0.4110
1/4	18	.5408	.5304	.5038	.4986	.4668	.4703	.4807	.5073	.5125	.5443
3/8	18	.6779	.6675	.6409	.6357	.6039	.6074	.6178	.6444	.6496	.6814
1/2	14	.8439	.8305	.7963	.7896	.7487	.7532	.7666	.8008	.8075	.8484
3/4	14	1.0543	1.0409	1.0067	1.0000	.9591	.9636	.9770	1.0112	1.0179	1.0588
1	11 1/2	1.3183	1.3020	1.2604	1.2523	1.2025	1.2079	1.2242	1.2658	1.2739	1.3237
1 1/4	11 1/2	1.6630	1.6467	1.6051	1.5970	1.5472	1.5526	1.5689	1.6106	1.6187	1.6685
1 1/2	11 1/2	1.9020	1.8857	1.8441	1.8360	1.7862	1.7916	1.8079	1.8495	1.8576	1.9074
2	11 1/2	2.3759	2.3596	2.3180	2.3099	2.2601	2.2655	2.2818	2.3234	2.3315	2.3813
2 1/2	8	2.8767	2.8533	2.7934	2.7817	2.7101	2.7179	2.7413	2.8012	2.8129	2.8845
3	8	3.5031	3.4797	3.4198	3.4081	3.3365	3.3443	3.3677	3.4276	3.4393	3.5109
3 1/2	8	4.0034	3.9800	3.9201	3.9084	3.8368	3.8446	3.8680	3.9279	3.9396	4.0112
4	8	4.5017	4.4783	4.4184	4.4067	4.3351	4.3429	4.3663	4.4262	4.4379	4.5095
5	8	5.5638	5.5404	5.4805	5.4688	5.3973	5.4051	5.4285	5.4884	5.5001	5.5716
6	8	6.6205	6.5971	6.5372	6.5255	6.4539	6.4617	6.4857	6.5450	6.5567	6.6283
8	8	8.6146	8.5912	8.5313	8.5196	8.4480	8.4558	8.4792	8.5391	8.5508	8.6224
10	8	10.7355	10.7121	10.6522	10.6405	10.5689	10.5767	10.6001	10.6600	10.6717	10.7433
12	8	12.7324	12.7090	12.6491	12.6374	12.5658	12.5736	12.5970	12.6569	12.6686	12.7402

[1] The major diameter of the external thread is usually determined by the outside diameter of the pipe. These maximum diameters result from adding the depth of the truncated thread, $0.666025p$, to the maximum pitch diameter in column 5, and it should be understood that commercial pipe will not always have these maximum diameters.

[2] Column 5 is the same as the pitch diameter at the end of internal thread E_1, table 59, increased by 4 turns.

[3] Column 6 is equal to column 5 reduced by 1½ turns.

[4] Column 10 is the same as the pitch diameter at the end of internal thread E_1, table 59, increased by 5 turns.

[5] Column 11 is equal to column 10 increased by 1½ turns.

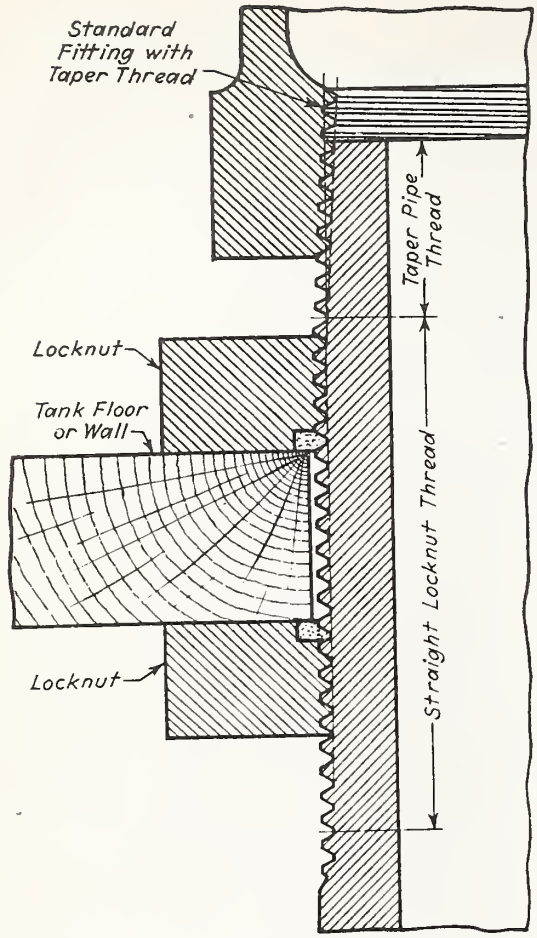


FIGURE 30.—*"Tank nipple" thread.*

(c) *Hose Nipples and Couplings.*—Hose coupling joints are ordinarily made with straight internal and external loose-fitting threads. There are several standards of hose threads having various diameters and pitches, one of which is based on the American National pipe thread. By the use of this thread series, dimensions of which are given in table 77, section VII, p. 144, opposite the designation "Steam, air, water, and all other hose connections," it is possible to join small hose couplings in sizes ½ to 2 in., inclusive, to ends of standard pipe having American National external taper pipe threads, using a gasket to seal the joint. The maximum pitch diameter of the nipple has the same value as the maximum pitch diameter of the external thread in table 72.

(c) GAGING OF STRAIGHT PIPE THREADS

1. TYPES OF GAGES.—Gages to control properly the production of these straight threads should be either straight "go" and "not go" thread gages or the regular American National taper pipe thread gages, as indicated below.

2. USE OF STRAIGHT AND TAPER THREAD GAGES.—Straight "go" and "not go" thread gages should be used for all types of threaded joints where both the external and internal threads are straight. Taper thread plug gages may be used for the internal threads of all types of mechanical thread joints where the external thread is tapered and the internal thread is straight.

3. GAGING PRESSURE-TIGHT JOINTS.—Taper thread gages shall be used to gage straight internal pipe threads forming part of pressure-tight joints where the external thread is tapered.

The gaging notch on American National taper pipe thread plug gage shall come flush with the end of American National internal straight pipe thread in couplings (NPSC, table 70) or with the bottom of the chamfer, if chamfered, allowing a tolerance of 1½ turns large or small to gage.

The gaging notch on the American National taper pipe thread plug gage as modified for checking internal straight pipe threads (NPSF), table 71, to assemble with the Dryseal taper pipe thread, tables 59 and 67, for automotive, fuel, and oil-line fittings, drain plugs, filler plugs, etc., shall come flush with the face or with the bottom of the chamfer, if chamfered, allowing a tolerance of no turns large and 1½ turns small, except that for the ⅛-in. size a tolerance of ½ turn small to 2 turns small is allowed, and for the ¼-in. size a tolerance of ½ turn large to 1 turn small is allowed.

4. GAGE DIMENSIONS.—The straight "go" and "not go" gages used for checking mechanical joint threads, tables 72 and 73, shall be made to the pitch diameters specified in the tables, in accordance with standard practice for straight thread gages, as given in table 8, section III.

5. Gage Tolerances.—The tolerances on all gages should be in accordance with the gage tolerances specified for American National taper pipe thread gages in table 63.

SECTION VII. AMERICAN NATIONAL HOSE-COUPLING AND FIRE-HOSE COUPLING THREADS[22]

Some years ago specifications for American National standard fire-hose coupling threads were approved by the National Board of Fire Underwriters, National Fire Protection Association, American Society of Mechanical Engineers, American Society of Municipal Improvements, New England Water Works Association, American Water Works Association, the National Bureau of Standards, and other interested organizations. These specifications were published in 1911 as the Specifications of the National Board of Fire Underwriters, recommended by the National Fire Protection Association and approved by the various other organizations. They were also published in 1914 as Circular C50 of the National Bureau of Standards. This circular was revised and republished in 1917.

When the National Screw Thread Commission took up its work on the standardization of screw threads, the specifications for fire-hose coupling threads above referred to were accepted as the basis of its work on fire-hose coupling threads. It was found, however, that the specifications as originally drawn were inadequate in that they specified nominal dimensions only, with no maximum and minimum limits. The limiting dimensions herein specified have met with general approval. State-wide adoption of the American National fire-hose coupling threads is completed in 16 States and the District of Columbia, and is under effective headway in 20 States. Their use has been made compulsory by State legislative acts in California, Massachusetts, Oregon, and Texas.

With regard to the American National hose-coupling threads, the purpose of this specification is to provide a standard which will be recognized and adopted at once by a majority of manufacturers and consumers and toward which the minority may be brought, thus eliminating many threads which have been in use and the confusion and misunderstandings that have prevailed.

As in other lines of work, current practice in use and manufacture must be recognized as well as the specific advantages of certain thread proportions for specific uses. This prevents the adoption of a single specification for each one of the nominal sizes.

These standards apply to the threaded parts of hose couplings, valves, nozzles, and all other fittings used in direct connection with hose intended for fire protection or for domestic, industrial, and general service in nominal sizes of ½, ⅝, ¾, 1, 1¼, 1½, and 2 inches.

In ordering threading tools[23] for producing American National hose-coupling and fire-hose coupling threads, it should be pointed out that new taps should be near the maximum permissible size of the coupling, and new dies near the minimum permissible size of the nipple, in order that reasonable wear may be provided. As the threading tools wear by use, the couplings will become smaller and the nipples larger until the limiting dimensions are reached. These must not be exceeded. When the product reaches, or comes dangerously close to

[22] These standards, in substantially the same form, and excepting tables 80 and 81, have been adopted by the American Standards Association. They are published as ASA B26-1925 "Fire Hose Coupling Screw Thread" and ASA B33.1-1935 "Hose Coupling Screw Threads" by the ASME, 29 West 39th St., New York 18, N. Y. (25 cents each).

[23] In the interest of the universal adoption of of the American National fire-hose threads throughout the United States, attention is directed to the fact that sets of tools for rethreading existing hydrants and hose couplings are commerically available. Such sets comprise roughing and finishing taps, roughing and finishing dies, expanders for expanding undersize externally threaded fittings preparatory to rethreading, gages, and various accessories. The tools are applicable where existing threaded fittings do not differ so widely from the American National standards as to leave insufficient stock for the new thread. By the use of such tools a considerable number of municipalities have at small expense converted their existing equipment and thus availed themselves of the important advantages which standardization affords.

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the limiting size, the threading tools should be readjusted or replaced.

1. FORM OF THREAD

1. ANGLE OF THREAD.—The basic angle of thread, A, between the sides of the thread measured in an axial plane is 60°. The line bisecting this 60° angle, is perpendicular to the axis of the screw thread.

2. FLAT AT CREST AND ROOT.—The flat at the root and crest of the basic thread form is $\frac{1}{8} \times p$, or $0.125 \times p$.

3. DEPTH OF THREAD.—The depth of the basic thread form is

$$h = 0.649519 \times p, \text{ or } h = \frac{0.649519}{n};$$

where

p = pitch in inches,
n = number of threads per inch,
h = basic depth of thread.

2. THREAD SERIES

(*a*) AMERICAN NATIONAL HOSE-COUPLING THREADS.—There are specified in table 74 a thread series and basic dimensions for hose-coupling threads which apply to the threaded parts of hose couplings, valves, nozzles, and all other fittings used in direct connection with hose intended for fire protection or for domestic, industrial, and general service in nominal sizes of ½, ⅝, ¾, 1, 1¼, 1½, and 2 inches. Symbols for designating these threads are "NH" for garden hose, chemical engine and booster hose, and fire protection hose; and "NPSH" for steam, air, water, and all other hose connections.

Examples:

Threaded part 1 inch diameter, 8 threads per inch, mark.....*1"-8NH.*

Threaded part 1 inch diameter, 11½ threads per inch, mark.....*1"-11½NPSH.*

TABLE 74.—*American National hose-coupling threads*

MINIMUM (BASIC) COUPLING DIMENSIONS

Nominal size of hose	Service	Number of threads per inch	Pitch	Depth of thread	Major diameter	Pitch diameter	Minor diameter	Allowance
1	2	3	4	5	6	7	8	9
Inches			*Inches*	*Inch*	*Inches*	*Inches*	*Inches*	*Inch*
½, ⅝, ¾	Garden hose	11½	0.08696	0.05648	1.0725	1.0160	0.9595	.....
¾, 1	Chemical engine and booster hose	8	.12500	.08119	1.3870	1.3058	1.2246	.....
1½	Fire-protection hose	9	.11111	.07217	2.0020	1.9298	1.8577	.....
½	Steam, air, water, and all other hose connections.	14	.07143	.04639	.8323	.7859	.7395	.....
¾		14	.07143	.04639	1.0428	.9964	.9500	.....
1		11½	.08696	.05648	1.3051	1.2486	1.1921	.....
1¼		11½	.08696	.05648	1.6499	1.5934	1.5369	.....
1½		11½	.08696	.05648	1.8888	1.8323	1.7758	.....
2		11½	.08696	.05648	2.3628	2.3063	2.2498	.....

MAXIMUM (BASIC) NIPPLE DIMENSIONS

½, ⅝, ¾	Garden hose	11½	0.08696	0.05648	1.0625	1.0060	0.9495	0.0100
¾, 1	Chemical-engine and booster hose	8	.12500	.08119	1.3750	1.2938	1.2126	.0120
1½	Fire-protection hose	9	.11111	.07217	1.9900	1.9178	1.8457	.0120
½	Steam, air, water, and all other hose connections.	14	.07143	.04639	.8248	.7784	.7320	.0075
¾		14	.07143	.04639	1.0353	.9889	.9425	.0075
1		11½	.08696	.05648	1.2951	1.2386	1.1821	.0100
1¼		11½	.08696	.05648	1.6399	1.5834	1.5269	.0100
1½		11½	.08696	.05648	1.8788	1.8223	1.7658	.0100
2		11½	.08696	.05648	2.3528	2.2963	2.2398	.0100

(*b*) AMERICAN NATIONAL FIRE-HOSE COUPLING THREADS.—There are specified in table 75 a thread series and basic dimensions for fire-hose couplings from 2½ to 4½ inches in diameter which will be known as the "American National fire-hose threads." These basic sizes and dimensions correspond in all details to those recommended by the National Fire Protection Association and by the National Bureau of Standards.

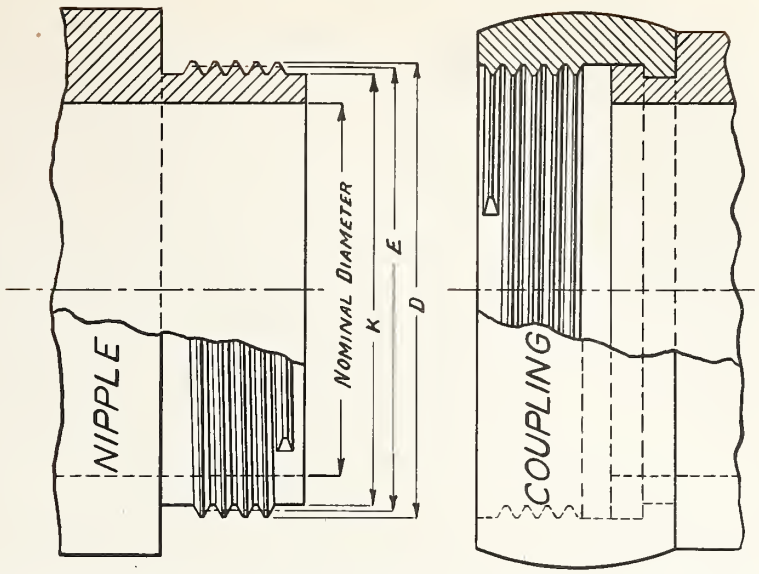


FIGURE 31.—*American National hose-coupling and American National fire-hose coupling threads.*

See tables 76, 77, 78, and 79 for dimensions and tolerances.

The American National fire-hose coupling thread is recommended for use on all couplings and hydrant connections for fire-protection systems, and for all other purposes where hose couplings and connections are required in sizes between 2½ and 4½ inches in diameter. The symbols for designating these threads is "NH". Example:

Threaded part 3 inches diameter, 6 threads per inch, mark.....*3"—6NH*

TABLE 75.—*American National fire-hose coupling threads*

MINIMUM (BASIC) COUPLING DIMENSIONS

Nominal size of hose	Number of threads per inch	Pitch	Depth of thread	Major diameter	Pitch diameter	Minor diameter	Allowance
1	2	3	4	5	6	7	8
Inches		*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inch*
2½....	7½	0.13333	0.08660	3.0836	2.9970	2.9104	.....
3.....	6	.16667	.10825	3.6389	3.5306	3.4223	.....
3½....	6	.16667	.10825	4.2639	4.1556	4.0473	.....
4½....	4	.25000	.16238	5.7859	5.6235	5.4611	.....

MAXIMUM (BASIC) NIPPLE DIMENSIONS

2½....	7½	0.13333	0.08660	3.0686	2.9820	2.8954	0.0150
3.....	6	.16667	.10825	3.6239	3.5156	3.4073	.0150
3½....	6	.16667	.10825	4.2439	4.1356	4.0273	.0200
4½....	4	.25000	.16238	5.7609	5.5985	5.4361	.0250

3. ALLOWANCES AND TOLERANCES

(*a*) Specified allowances and tolerances, given in table 76, apply to American National hose-coupling and American National fire-hose coupling threads. The tolerances represent extreme variations permitted on the product. There are shown, in figure 32, the relations between nipple and coupling dimensions and thread form as specified herein.

(*b*) The tolerance on the coupling is plus, and is applied from the minimum coupling dimension to above the minimum coupling dimension.

(*c*) The tolerance on the nipple is minus, and is applied from the maximum nipple dimension to below the maximum nipple dimension.

(*d*) The pitch diameter tolerances provided for a mating nipple and coupling are the same.

(*e*) Pitch diameter tolerances include lead and angle variations. (See footnote 1, table 76.)

(*f*) The tolerance on the major diameter is twice the tolerance on the pitch diameter.

(*g*) The tolerance on the minor diameter of the nipple is equal to the tolerance on

pitch diameter plus two ninths of the basic thread depth. The minimum minor diameter of a nipple is such as to result in a flat equal to one third of the basic flat ($\frac{1}{24} \times p$) at the root when the pitch diameter of the nipple is at its minimum value. The maximum minor diameter is basic, but may be such as results from the use of a worn or rounded threading tool.

(*h*) The tolerance on major diameter of the coupling is equal to the tolerance on pitch diameter plus two ninths of the basic thread depth. The minimum major diameter of the coupling is such as to result in a basic flat ($\frac{1}{8} \times p$) when the pitch diameter of the coupling is at its minimum value. The maximum major diameter of the coupling is that corresponding to a flat equal to one third the basic flat ($\frac{1}{24} \times p$).

(*i*) The tolerance on the minor diameter of the coupling is twice the tolerance on pitch diameter of the coupling. The minimum minor diameter of a coupling is such as to result in a basic flat ($\frac{1}{8} \times p$) at the crest when the pitch diameter of the coupling is at its minimum value.

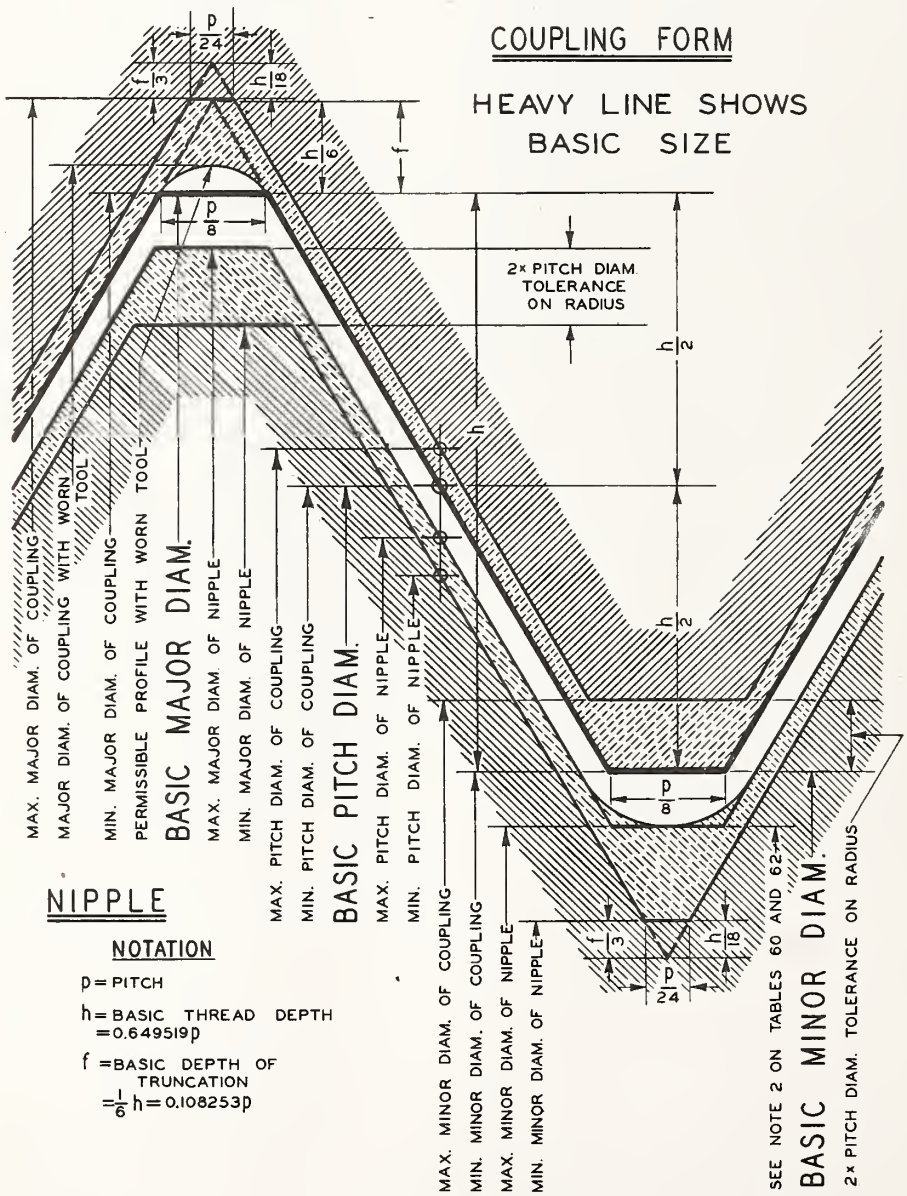


FIGURE 32.—*American National hose-coupling and American National fire-hose coupling threads.*

TABLE 76.—*Tolerances and allowances for American National hose-coupling and American National fire-hose coupling threads*

Nominal size of hose	Service	Threads per inch	Allowances	Tolerances on pitch diameter[1]	Lead errors consuming one half of pitch-diameter tolerances[2]	Errors in half angle consuming one half of pitch-diameter tolerances	
1	2	3	4	5	6	7	
Inches			*Inch*	*Inch*	*Inch*	*Deg.*	*Min.*
½, ⅝, ¾	Garden hose	11½	0.0100	0.0085	0.0025	1	52
¾, 1	Chemical engine and booster hose	8	.0120	.0111	.0032	1	42
1½	Fire protection hose	9	.0120	.0111	.0032	1	54
½	Steam, air, water, and all other hose connections.	14	.0075	.0070	.0020	1	52
¾		14	.0075	.0070	.0020	1	52
1		11½	.0100	.0085	.0025	1	52
1¼		11½	.0100	.0085	.0025	1	52
1½		11½	.0100	.0085	.0025	1	52
2		11½	.0100	.0085	.0025	1	52
2½	Fire hose	7½	.0150	.0160	.0046	2	17
3		6	.0150	.0180	.0052	2	4
3½		6	.0200	.0180	.0052	2	4
4½		4	.0250	.0250	.0072	1	55

[1] The tolerances specified for pitch diameter include all errors of pitch diameter, lead, and angle. The full tolerance cannot, therefore, be used on pitch diameter unless the lead and angle of the thread are perfect. Columns 6 and 7 give, for information, the errors in lead (per length of thread engaged) and in angle, each of which can be compensated for by half the tolerance on the pitch diameter given in column 5. If lead and angle errors both exist to the amount tabulated, the pitch diameter of a nipple, for example, must be reduced by the full tolerance or it will not pass the "go" gage.

[2] Between any two threads not farther apart than the length of engagement.

4. TABLES OF LIMITING DIMENSIONS

TABLE 77.—*Limiting dimensions and tolerances, American National hose-coupling threads*

COUPLING THREAD

Nominal size of hose	Service	Threads per inch	Pitch	Depth of thread	Major diameter			Pitch diameter			Minor diameter		
					Maximum	Tolerance	Minimum	Maximum	Tolerance	Minimum	Maximum	Tolerance	Minimum
1	2	3	4	5	6	7	8	9	10	11	12	13	14
In.			*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
½, ⅝, ¾	Garden hose	11½	0.08696	0.05648	.....	.....	[1]1.0725	1.0245	0.0085	1.0160	0.9765	0.0170	0.9595
¾, 1	Chemical engine and booster hose.	8	.12500	.08119	.....	.....	[1]1.3870	1.3169	.0111	1.3058	1.2468	.0222	1.2246
1½	Fire protection hose.	9	.11111	.07217	.....	.....	[1]2.0020	1.9409	.0111	1.9298	1.8799	.0222	1.8577
½	Steam, air, water and all other hose connections.	14	.07143	.04639	.....	.....	[1].8323	.7929	.0070	.7859	.7535	.0140	.7395
¾		14	.07143	.04639	.....	.....	[1]1.0428	1.0034	.0070	.9964	.9640	.0140	.9500
1		11½	.08696	.05648	.....	.....	[1]1.3051	1.2571	.0085	1.2486	1.2091	.0170	1.1921
1¼		11½	.08696	.05648	.....	.....	[1]1.6499	1.6019	.0085	1.5934	1.5539	.0170	1.5369
1½		11½	.08696	.05648	.....	.....	[1]1.8888	1.8408	.0085	1.8323	1.7928	.0170	1.7758
2		11½	.08696	.05648	.....	.....	[1]2.3628	2.3148	.0085	2.3063	2.2668	.0170	2.2498

[1] Dimensions for the minimum major diameter of the coupling correspond to the basic flat ($\frac{1}{8} \times p$), and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the coupling shall be that corresponding to a flat at the major diameter of the maximum coupling equal to $\frac{1}{24} \times p$, and may be determined by adding $1\frac{2}{3} \times h$ (or $0.7939p$) to the maximum pitch diameter of the coupling.

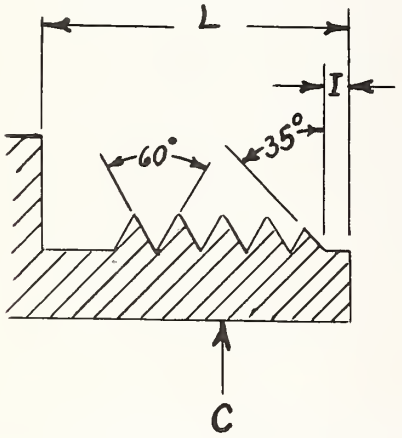
TABLE 77.—*Limiting dimensions and tolerances, American National hose-coupling threads*—Continued

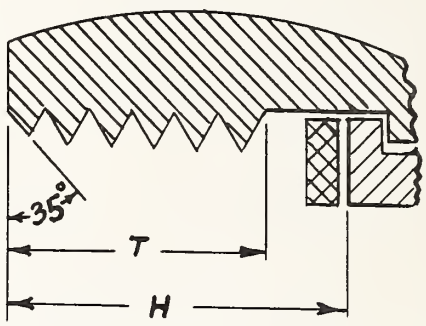
NIPPLE THREAD

Nominal size of hose	Service	Threads per inch	Pitch	Depth of thread	Major diameter			Pitch diameter			Minor diameter		
					Maximum	Tolerance	Minimum	Maximum	Tolerance	Minimum	Maximum	Tolerance	Minimum
1	2	3	4	5	6	7	8	9	10	11	12	13	14
In.			*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
½, ⅝, ¾	Garden hose	11½	0.08696	0.05648	1.0625	0.0170	1.0455	1.0060	0.0085	0.9975	[2]0.9495	.....	.....
¾, 1	Chemical engine and booster hose.	8	.12500	.08119	1.3750	.0222	1.3528	1.2938	.0111	1.2827	[2]1.2126	.....	.....
1½	Fire protection hose.	9	.11111	.07217	1.9900	.0222	1.9678	1.9178	.0111	1.9067	[2]1.8457	.....	.....
½	Steam, air, water and all other hose connections.	14	.07143	.04639	.8248	.0140	.8108	.7784	.0070	.7714	[2].7320	.....	.....
¾		14	.07143	.04639	1.0353	.0140	1.0213	.9889	.0070	.9819	[2].9425	.....	.....
1		11½	.08696	.05648	1.2951	.0170	1.2781	1.2386	.0085	1.2301	[2]1.1821	.....	.....
1¼		11½	.08696	.05648	1.6399	.0170	1.6229	1.5834	.0085	1.5749	[2]1.5269	.....	.....
1½		11½	.08696	.05648	1.8788	.0170	1.8618	1.8223	.0085	1.8138	[2]1.7658	.....	.....
2		11½	.08696	.05648	2.3528	.0170	2.3358	2.2963	.0085	2.2878	[2]2.2398	.....	.....

[2]Dimensions given for the maximum minor diameter of the nipple are figured to the intersection of the worn tool arc with a center line through crest and root. The minimum minor diameter of the nipple shall be that corresponding to a flat at the minor diameter of the minimum nipple equal to $\frac{1}{24} \times p$, and may be determined by subtracting $\frac{19}{9} \times h$ (or $0.7939p$) from the minimum pitch diameter of the nipple.

TABLE 78.—*Lengths of threads for American National hose-coupling threads and American National fire-hose coupling threads*





Nominal size of hose	Service	Threads per inch, *n*	Length of nipple, *L*	Depth of coupling, *H*	Thread length for coupling, *T*	Length of pilot, *I*	Inside diameter of nipple, maximum, *C*	Approximate number of threads in length *T*
1	2	3	4	5	6	7	8	9
Inches			*Inches*	*Inches*	*Inch*	*Inch*	*Inches*	
½, ⅝, ¾	Garden hose	11½	9/16	17/32	3/8	1/8	25/32	4¼
¾, 1	Chemical engine and booster hose	8	5/8	19/32	15/32	5/32	1 1/32	3¾
1½	Fire protection hose	9	5/8	19/32	15/32	5/32	1 17/32	4¼
½	Steam, air, water, and all other hose connections.	14	½	15/32	5/16	1/8	17/32	1¼
¾		14	9/16	17/32	3/8	1/8	25/32	5¼
1		11½	9/16	17/32	3/8	5/32	1 1/32	1¼
1¼		11½	5/8	19/32	15/32	5/32	1 9/32	5½
1½		11½	5/8	19/32	15/32	5/32	1 17/32	5½
2		11½	¾	23/32	19/32	3/16	2 1/32	6¾
2½	Fire hose	7½	1	15/16	1 1/16	¼	2 17/32	5¼
3		6	1 1/8	1 1/16	1 3/16	5/16	3 1/32	5
3½		6	1 1/8	1 1/16	1 3/16	5/16	3 17/32	5
4½		4	1¼	1 3/16	1 5/16	7/16	4 17/32	3¾

TABLE 79.—*Limiting dimensions and tolerances, American National fire-hose coupling threads*

COUPLING THREAD

Nominal size of hose	Threads per inch	Pitch	Depth of thread	Major diameter			Pitch diameter			Minor diameter		
				Maximum	Tolerance	Minimum	Maximum	Tolerance	Minimum	Maximum	Tolerance	Minimum
1	2	3	4	5	6	7	8	9	10	11	12	13
Inches		*Inch*	*Inch*	*Inches*	*Inch*	*Inches*	*Inches*	*Inch*	*Inches*	*Inches*	*Inch*	*Inches*
2½	7½	0.13333	0.08660	.....	.....	[1]3.0836	3.0130	0.0160	2.9970	2.9424	0.0320	2.9104
3	6	.16667	.10825+	.....	.....	[1]3.6389	3.5486	.0180	3.5306	3.4583	.0360	3.4223
3½	6	.16667	.10825+	.....	.....	[1]4.2639	4.1736	.0180	4.1556	4.0833	.0360	4.0473
4½	4	.25000	.16238	.....	.....	[1]5.7859	5.6485	.0250	5.6235	5.5111	.0500	5.4611
NIPPLE THREAD												
2½	7½	0.13333	0.08660	3.0686	0.0320	3.0366	2.9820	0.0160	2.9660	[2]2.8954	.....	.....
3	6	.16667	.10825+	3.6239	.0360	3.5879	3.5156	.0180	3.4976	[2]3.4073	.....	.....
3½	6	.16667	.10825+	4.2439	.0360	4.2079	4.1356	.0180	4.1176	[2]4.0273	.....	.....
4½	4	.25000	.16238	5.7609	.0500	5.7109	5.5985	.0250	5.5735	[2]5.4361	.....	.....

[1]Dimensions for the minimum major diameter of the coupling correspond to the basic flat ($\frac{1}{8} \times p$), and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the coupling shall be that corresponding to a flat at the major diameter of the maximum coupling equal to $\frac{1}{24} \times p$, and may be determined by adding $1\frac{2}{3} \times h$ (or $0.7939p$) to the maximum pitch diameter of the coupling.

[2]Dimensions given for the maximum minor diameter of the nipple are figured to the intersection of the worn tool arc with a center line through crest and root. The minimum minor diameter of the nipple shall be that corresponding to a flat at the minor diameter of the minimum nipple equal to $\frac{1}{24} \times p$, and may be determined by subtracting $1\frac{2}{3} \times h$ (or $0.7939p$) from the minimum pitch diameter of the nipple.

5. GAGES

(*a*) GAGES FOR AMERICAN NATIONAL HOSE-COUPLING THREADS.—Limiting dimensions of gages for American National hose-coupling threads are given in tables 80 and 81, and are based on the specifications and tolerances for gages given in section III.

(*b*) GAGES FOR AMERICAN NATIONAL FIRE-HOSE COUPLING THREADS.—It is recommended that American National fire-hose coupling threads be inspected in the field by means of gages made within the tolerances given in table 82. Limiting dimensions for these gages are given in tables 83 and 84.

It is further recommended that American National fire-hose coupling threads be given final inspection by the manufacturer by means of gages made within the limiting dimensions given in tables 83 and 84, by whatever amount may be desired, in order to avoid, as far as possible, disagreements which might otherwise arise as the result of slight differences in the sizes of gages.

TABLE 80.—*Limiting dimensions of setting plug and thread ring gages and plain gages for coupling nipples (external threads), American National hose-coupling threads*

Limiting dimensions		Service								
		Garden hose	Chemical engine and booster hose	Fire protection hose	Steam, air, water, and all other hose connections					
		Size								
		½, ⅝, ¾	¾, 1	1½	½	¾	1	1¼	1½	2
		Threads per inch								
		11½	8	9	14	14	11½	11½	11½	11½
"GO" THREAD GAGES FOR NIPPLES										
		Inches	*Inches*	*Inches*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Max....	1.0625	1.3750	1.9900	0.8248	1.0353	1.2951	1.6399	1.8788	2.3528
	Min....	1.0619	1.3743	1.9893	.8242	1.0347	1.2945	1.6393	1.8782	2.3522
Major diameter of truncated portion of truncated setting plug.....	Max....	1.0455	1.3528	1.9678	.8108	1.0213	1.2781	1.6229	1.8618	2.3358
	Min....	1.0449	1.3521	1.9671	.8102	1.0207	1.2775	1.6223	1.8612	2.3352
Pitch diameter of setting plug or ring gage.....	Max X..	1.0060	1.2938	1.9178	.7784	.9889	1.2386	1.5834	1.8223	2.2963
	Min X..	1.0057	1.2934	1.9175	.7781	.9886	1.2383	1.5831	1.8220	2.2959
	Max Y..	1.0058	1.2936	1.9176	.7782	.9887	1.2384	1.5832	1.8221	2.2961
	Min Y..	1.0054	1.2931	1.9171	.7778	.9883	1.2380	1.5828	1.8217	2.2955
Minor diameter of ring gage.....	Max....	.9595	1.2246	1.8577	.7395	.9500	1.1921	1.5369	1.7758	2.2498
	Min....	.9589	1.2239	1.8570	.7389	.9494	1.1915	1.5363	1.7752	2.2492
"NOT GO" THREAD GAGES FOR NIPPLES										
Major diameter of full-form setting plug, and full portion of truncated setting plug.	Min....	1.0619	1.3743	1.9893	.8242	1.0347	1.2945	1.6393	1.8782	2.3522
	Max....	1.0625	1.3750	1.9900	.8248	1.0353	1.2951	1.6399	1.8788	2.3528
Major diameter of truncated portion of truncated setting plug.....	Min....	1.0346	1.3361	1.9541	.8017	1.0122	1.2672	1.6120	1.8509	2.3249
	Max....	1.0352	1.3368	1.9548	.8023	1.0128	1.2678	1.6126	1.8515	2.3255
Pitch diameter of setting plug or ring gage.....	Min....	0.9975	1.2827	1.9067	.7714	.9819	1.2301	1.5749	1.8138	2.2878
	Max....	.9978	1.2831	1.9070	.7717	.9822	1.2304	1.5752	1.8141	2.2882
Minor diameter of ring gage.....	Min....	.9787	1.2556	1.8826	.7559	.9664	1.2113	1.5561	1.7950	2.2690
	Max....	.9793	1.2563	1.8833	.7565	.9670	1.2119	1.5567	1.7956	2.2696
PLAIN GAGES FOR NIPPLES										
"Go" gages for major diameter.....	Max....	1.06250	1.37500	1.99000	.82480	1.03530	1.29510	1.63990	1.87880	2.35280
	Min....	1.06241	1.37491	1.98988	.82473	1.03521	1.29501	1.63978	1.87868	2.35268
"Not go" gages for major diameter.....	Min....	1.04550	1.35280	1.96780	.81080	1.02130	1.27810	1.62290	1.86180	2.33580
	Max....	1.04559	1.35289	1.96792	.81087	1.02139	1.27819	1.62302	1.86192	2.33592

TABLE 81.—*Limiting dimensions of thread plug and plain gages for couplings (internal threads), American National hose-coupling threads*

Limiting dimensions	Service								
	Garden hose	Chemical engine and booster hose	Fire protection hose	Steam, air, water, and all other hose connections					
	Size								
	½, ⅝, ¾	¾, 1	1½	½	¾	1	1¼	1½	2
	Threads per inch								
	11½	8	9	14	14	11½	11½	11½	11½
"GO" THREAD GAGES FOR COUPLINGS									
	Inches	*Inches*	*Inches*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Major diameter of plug gage { Min....	1.0725	1.3870	2.0020	0.8323	1.0428	1.3051	1.6499	1.8888	2.3628
Max....	1.0731	1.3877	2.0027	.8329	1.0434	1.3057	1.6505	1.8894	2.3634
Pitch diameter of plug gage { Min....	1.0160	1.3058	1.9298	.7859	0.9964	1.2486	1.5934	1.8323	2.3063
Max....	1.0163	1.3062	1.9301	.7862	.9967	1.2489	1.5937	1.8326	2.3067
"NOT GO" THREAD GAGES FOR COUPLINGS									
Major diameter of plug gage { Max....	1.0622	1.3710	1.9890	.8238	1.0343	1.2948	1.6396	1.8785	2.3525
Min....	1.0616	1.3703	1.9883	.8232	1.0337	1.2942	1.6390	1.8779	2.3519
Pitch diameter of thread plug gage. { Max....	1.0245	1.3169	1.9409	.7929	1.0034	1.2571	1.6019	1.8408	2.3148
Min....	1.0242	1.3165	1.9406	.7926	1.0031	1.2568	1.6016	1.8405	2.3144
PLAIN GAGES FOR COUPLINGS									
"Go" gages for minor diameter { Min....	0.95950	1.22460	1.85770	.73950	0.95000	1.19210	1.53690	1.77580	2.24980
Max....	.95959	1.22469	1.85782	.73957	.95009	1.19219	1.53702	1.77592	2.24992
"Not go" gages for minor diameter. { Max....	.97650	1.24680	1.87990	.75350	.96400	1.20910	1.55390	1.79280	2.26680
Min....	.97641	1.24671	1.87978	.75343	.96391	1.20901	1.55378	1.79268	2.26668

TABLE 82.—*Tolerances on gages for American National fire-hose coupling threads*

Allowable variation in lead between any two threads not farther apart than length of engagement	Allowable variation in one half angle of thread	Tolerance on diameter of minimum thread gage	Tolerance on diameter of maximum thread gage
1	2	3	4
Inch	*Deg. Min.*	*Inch*	*Inch*
±0.0005	±0 10	−0.000 +.001	+0.000 −.001

TABLE 83.—*Limiting dimensions of field inspection thread plug gages for fire-hose couplings (internal threads)*[1]

Nominal size of hose	Threads per inch	"Go" or minimum gage				"Not go" or maximum gage			
		Major diameter		Pitch diameter		Major diameter		Pitch diameter	
		Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10
Inches		*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
2.500	7½	3.0846	3.0836	2.9980	2.9970	3.0836	3.0826	3.0130	3.0120
3.000	6	3.6399	3.6389	3.5316	3.5306	3.6389	3.6379	3.5186	3.5476
3.500	6	4.2649	4.2639	4.1566	4.1556	4.2639	4.2629	4.1736	4.1726
4.500	4	5.7869	5.7859	5.6245	5.6235	5.7859	5.7849	5.6485	5.6475

[1] The minor diameters of plug gages and the major diameters of ring gages are undercut beyond the nominal diameters to give a clearance for grinding or lapping. The allowable variation in lead between any two threads not farther apart than the length of engagement is ±0.0005 inch. The allowable variation in one half angle of thread is ±10 minutes.

TABLE 84.—*Limiting dimensions of field inspection thread ring gages for fire-hose coupling nipples (external threads)*[1]

Nominal size of hose	Threads per inch	"Go" or maximum gage				"Not go" or minimum gage			
		Pitch diameter		Minor diameter		Pitch diameter		Minor diameter	
		Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10
Inches		*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
2.500	7½	2.9820	2.9810	2.9104	2.9094	2.9670	2.9660	2.9114	2.9104
3.000	6	3.5156	3.5146	3.4223	3.4213	3.4986	3.4976	3.4233	3.4223
3.500	6	4.1356	4.1346	4.0473	4.0463	4.1186	4.1176	4.0483	4.0473
4.500	4	5.5985	5.5975	5.4611	5.4601	5.5745	5.5735	5.4621	5.4611

[1] The minor diameters of plug gages and the major diameters of ring gages are undercut beyond the nominal diameters to give clearance for grinding or lapping. The allowable variation in lead between any two threads not farther apart than the length of engagement is ±0.0005 inch. The allowable variation in one half angle of thread is ±10 minutes.

SECTION VIII. MISCELLANEOUS STANDARDIZED PRODUCT THREADS OF AMERICAN NATIONAL FORM, OR AMERICAN NATIONAL PIPE THREAD FORM

1. GAS CYLINDER VALVE THREADS

The valves for cylinders containing compressed gases embody several screw threads, namely: (1) The outlet connection, (2) the neck, or valve to cylinder connection, (3) the safety device cap or plug, and (4) the various threads associated with the valve mechanism. Standards for thread dimensions of (1) and (2), the outlet and neck connections, have been developed and are specified below.

(a) OUTLET CONNECTIONS

Standard sizes of threads for gas cylinder valve outlet connections of various types are presented in table 85. The purpose of these standards is to prevent cross-connections of equipment used with a given type of valve, with another type where such may be dangerous or undesirable, as well as to promote interchangeability among threads of a given type of valve.

Gages for the "NS" and "NPS" threads specified in table 85 shall be made in accordance with the gage specifications in section III. Gages for the "NPT" threads shall be made in accordance with the gage specifications in section VI.

(b) NECK CONNECTIONS

The screw threads on the neck connection on the valve and in the cylinder neck are taper pipe threads in the sizes and lengths given in table 86.

Gages for these connections are threaded taper and plain taper plug and ring gages of special design, for which dimensions are given in tables 87A, 87B, and 87C. Threads in the cylinder neck shall be gaged to the bottom of the chamfer.

1. THREAD PLUG AND RING GAGES.—Thread plug and ring gages have three notches or steps, and are similar to those described on p. 123 and illustrated in figure 26. The notches are designated *B*, basic; *MX*, one turn large; and *MN*, one turn small. The tolerances for taper thread gages in table 63 are applicable.

(a) Thread plug gages for internal threads.—The thread plug gages for the internal thread in the cylinder neck are as follows: (1) One thread plug, designated L_1 gage, with length from basic notch, *B*, to end equal to L_1, table 59, and pitch diameter, at basic notch, *B*, equal to E_1, with crests of thread truncated $0.15p$. (2) One thread plug, designated L_7 gage, with length from basic notch equal to $L_1 + 5$ threads; basic pitch diameter at small end designated E_7 shall be based on a basic pitch diameter of E_1 at basic notch the same as the L_1 plug, and with crests of threads truncated 0.0056 in. ($=0.078p$) for the ½"-14 and

¾" - 14 sizes, and 0.0064 in. (= 0.073*p*), for the 1" - 11½ size. This gage shall have six threads, starting at the small end, the threads at the large end being removed to a depth of 0.02 in. on diameter below sharp V, leaving a finished cone tapered 1 to 16 on diameter.

It should be noted that the L_7 plug gage is two threads longer than the L_3 plug gage used for *AN* pipe threads described in par. (c) 2, p. 124.

(b) Thread ring gages for external threads. The thread ring gages for the external thread on the valve are as follows: (1) One thread ring, designated L_1 gage, of length L_1 from basic notch, tables 59 and 87A, and pitch diameter, E_0, at basic notch, *B*, with crests of threads truncated 0.15*p*. (2) One thread ring gage, designated L_8 gage, with length from basic notch, *B*, equal $L_1 + 5$ threads. The pitch diameter at the large end, designated E_8, shall be based on a basic pitch diameter, E_0, the same as L_1 ring, with crests of thread truncated 0.0056 in. (=0.078*p*) for the ½" - 14 and ¾" - 14 sizes, and 0.0064 in. (= 0.073*p*) for the 1" - 11½ size. This gage shall have 6 threads at the large end, the threads at small end being removed to a depth 0.02 inch on diameter beyond a sharp V, leaving a finished conical cavity tapered 1 to 16 on diameter.

It should be noted that the L_8 ring is longer than the L_2 *AN* pipe thread ring gage described in par. (c) 2, p. 124.

2. PLAIN TAPER PLUG AND RING GAGES.—The plain taper plug and ring gages have the same length to basic notch as the L_1 thread gages, with six notches or steps, corresponding to *B*, basic, with minimum crest truncation; B_t, basic with maximum crest truncation; *MN*, one turn small with minimum truncation; MN_t, one turn small with maximum truncation; *MX*, one turn large with minimum truncation; and MX_t, one turn large with maximum truncation. Dimensions of plain plug gages are shown in table 87B and plain ring gages in table 87C.

An alternative to the plain ring gage is the plain triroll gage described in par. (c), p. 124.

TABLE 85.—*American practice for screw threads of compressed gas cylinder discharge connections*

Gas	Symbol[1] (designation of thread)	Threads per inch	Valve outlet, external thread					Length of thread	Appliance nut threads, internal thread					Inlet connection	
			Major diameter		Pitch diameter		Minor diameter		Minor diameter		Pitch diameter		Major diameter	American National taper external pipe thread	
			Max	Min	Max	Min	Max		Min	Max	Min	Max	Min	Size	Length[3]
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			Inches	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*	*Inch*	*Inches*
Acetylene	0.825"-14NS-2...	14	0.825	0.815	0.7786	0.7737	0.737	5/8	.....	.....	.....	.....	.....	3/4, 1	7/8, 1
	0.830"-14NS-2...	14	.....	.....	.....	.....	.....	.....	0.753	0.760	0.7836	0.7885	0.830	.....	.....
Air, water pumped	0.903"-14NS-2...	14	.903	.893	.8566	.8517	.815	5/8	.....	.....	.....	.....	.....	3/4	7/8
	0.908"-14NS-2...	14	.....	.....	.....	.....	.....	.....	.831	.838	.8616	.8665	.908	.....	.....
Air, oil pumped	0.903"-14NS-2LH	14	.903	.893	.8566	.8517	.815	5/8	.....	.....	.....	.....	.....	3/4	7/8
	0.908"-14NS-2LH	14	.....	.....	.....	.....	.....	.....	.831	.838	.8616	.8665	.908	.....	.....
Ammonia, anhydrous	3/8"-18NPT....	18	3/8" American National internal pipe thread											3/4	7/8
Carbon dioxide[2]	0.825"-14NS-2...	14	.825	.815	.7786	.7737	.737	5/8	.....	.....	.....	.....	.....	3/4	7/8
	0.830"-14NS-2...	14	.....	.....	.....	.....	.....	.....	.753	.760	.7836	.7885	.830	.....	.....
Carbon dioxide[4]	0.903"-14NS-2...	14	.903	.893	.8566	.8517	.815	5/8	.....	.....	.....	.....	.....	3/4	7/8
	0.908"-14NS-2...	.....	.....	.....	.....	.....	.....	.....	.831	.838	.8616	.8665	.908	.....	.....
Chlorine	1.034"-14NPS....	14	1.034	1.030	.9835	.9795	.933	3/8	.....	.....	.....	.....	.....	3/4	1 1/8
	1.035"-14NPS....	14	.....	.....	.....	.....	.....	.....	.940	.963	.9845	.9885	1.035	.....	.....
Dichlorodifluoro-methane (Freeon)[4]	3/4"-14NPS....	14	1.031	1.025	.9717	.9677	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ethyl chloride[4]	1/2"-14NPS....	14	0.835	0.829	.7780	.7740	.....	.....	.....	.....	.....	.....	.....	.....	.....
Helium[2]	0.830"-14NS-2LH	14	.830	.820	.7836	.7787	.742	5/8	.....	.....	.....	.....	.....	3/4	7/8
	0.835"-14NS-2LH	14	.....	.....	.....	.....	.....	.....	.758	.765	.7886	.7935	.835	.....	.....
Hydrogen[2]	0.830"-14NS-2LH	14	.830	.820	.7836	.7787	.742	5/8	.....	.....	.....	.....	.....	3/4	7/8
	0.835"-14NS-2LH	14	.....	.....	.....	.....	.....	.....	.758	.765	.7886	.7935	.835	.....	.....
Nitrogen, water[2] pumped	0.903"-14NS-2...	14	.903	.893	.8566	.8517	.815	5/8	.....	.....	.....	.....	.....	3/4	7/8
	0.908"-14NS-2...	14	.....	.....	.....	.....	.....	.....	.831	.838	.8616	.8665	.908	.....	.....
Nitrogen, oil[2] pumped	0.903"-14NS-2LH	14	.903	.893	.8566	.8517	.815	5/8	.....	.....	.....	.....	.....	3/4	7/8
	0.908"-14NS-2LH	14	.....	.....	.....	.....	.....	.....	.831	.838	.8616	.8665	.908	.....	.....
Nitrous oxide	0.825"-14NS-2...	14	.825	.815	.7786	.7737	.737	5/8	.....	.....	.....	.....	.....	1/2	3/4
	0.830"-14NS-2...	14	.....	.....	.....	.....	.....	.....	.753	.760	.7836	.7885	.830	.....	.....
Oxygen[2]	0.903"-14NS-2...	14	.903	.893	.8566	.8517	.815	5/8	.....	.....	.....	.....	.....	1/2, 3/4, 1	3/4, 7/8, 1
	0.908"-14NS-2...	14	.....	.....	.....	.....	.....	.....	.831	.838	.8616	.8665	.908	.....	.....
Oxygen (medical)	0.825"-14NS-2...	14	.825	.815	.7786	.7737	.737	5/8	.....	.....	.....	.....	.....	1/2	3/4
	0.830"-14NS-2...	14	.....	.....	.....	.....	.....	.....	.753	.760	.7836	.7885	.830	.....	.....

[1] For explanation of symbols see p. 4. All outlet threads on valves are external except for anhydrous ammonia, and all are right-hand except where the symbol "LH" is shown. After considerable investigation and study, an allowance between the external and internal threads is provided to enable connection to the wide variety of threads which are out in the field and to compensate for minor discrepancies in existing specifications. 14NS stands for American National special straight threads 14 threads per inch.

[2] These thread sizes are Joint Army-Navy standards with previously used class 3 tolerances changed to class 2 tolerances. The minimum pitch diameter of the external thread and the maximum pitch diameter of the internal thread have been determined by applying the class 2 tolerances, as authorized at the general conference called by Conservation Division of the War Production Board and held in Washington, D. C., March 16, 1944.

[3] Cylinder valve inlet connection to be threaded entire length. The threads shall be full form, smooth, clean, and concentric to the axis of the valve.

[4] U. S. Navy standard defined in 45V13 (int.).

TABLE 86.—*Use of taper pipe threads on neck connection of compressed gas cylinders and valves*

Gas	Size	Symbol[1] (designation of thread)	Length[2]	Remarks
1	2	3	4	5
	Inch		*Inches*	
Acetylene	¾	¾"-14NPT	⅞	
	1	1"-11½NPT	1	
Air, water pumped	¾	¾"-14NPT	⅞	
Air, oil pumped	¾	¾"-14NPT	⅞	
Ammonia, anhydrous	¾	¾"-14NPT	⅞	
Carbon dioxide	¾	¾"-14NPT	⅞	
Chlorine No. 1	¾	¾"-14NPT	1⅛	Regular pipe thread.
Chlorine No. 2[3]	¾	¾"-14NPT-Spec.	1⅛	Oversize 0.0179 in. (4turns).
Chlorine No. 3[3]	¾	¾"-14NPT-Spec.	1⅛	Oversize 0.0380 in. (8½ turns).
Chlorine No. 4[3]	¾	¾"-14NPT-Spec.	1⅛	Oversize 0.0625 in. (14 turns).
Helium	¾	¾"-14NPT	⅞	
Hydrogen	¾	¾"-14NPT	⅞	
Nitrogen, water pumped	¾	¾"-14NPT	⅞	
Nitrogen, oil pumped	¾	¾"-14NPT	⅞	
Nitrous oxide	½	½"-14NPT	¾	
Oxygen	½	½"-14NPT	¾	
	¾	¾"-14NPT	⅞	
	1	1"-14NPT	1	
Oxygen (medical)	½	½"-14NPT	¾	

[1] The symbol ¾"-NPT stands for American National pipe threads, the ¾ in. size having 14 threads per inch.

[2] The valve neck shall be threaded the entire length indicated in this column. The threads shall be full form, smooth, clean, and concentric to the axis of the valve.

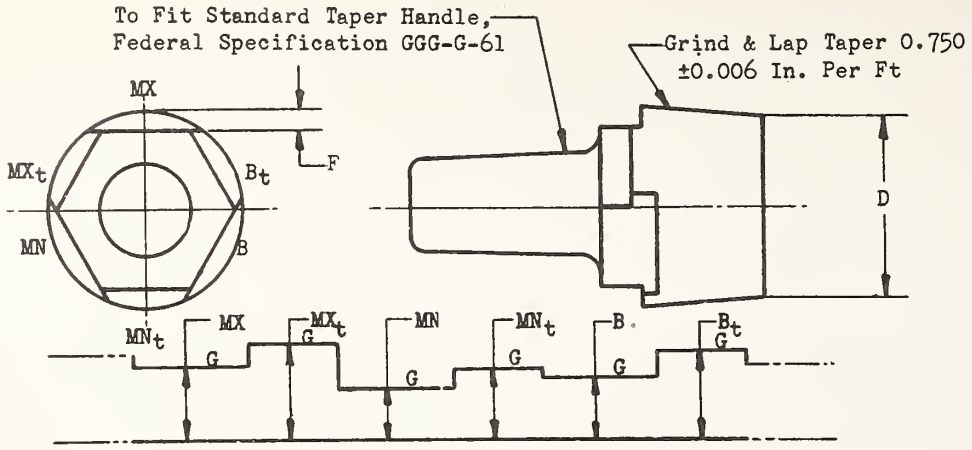
[3] All four sizes are of the American National pipe thread form. Numbers 2, 3, and 4, are valves made to fit enlarged threads in cylinders.

TABLE 87A.—*Dimensions of taper thread plug and ring gages for gas cylinder neck connections*

Size	Plug and ring gages			Plug gages			Ring gages		
	Gage symbol	Length from basic notch	Pitch diameter, F_1, at basic notch of plug, large end of L_1 ring	Major diameter		Pitch diameter at small end	Minor diameter		Pitch diameter at large end
				At basic notch of L_1 plug	At small end		At small end of L_1 ring	At large end	
1	2	3	4	5	6	7	8	9	10
		Inch	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
½"-14	L_1	0.3200	0.77843	0.81886	0.79886	0.75843	0.71800	0.73800	.....
	L_7, plug	.6771	.....	.....	.78682	.73611	.....	.....	.....
	L_8, ring	.6771	.....	.....	.....	.....	.....	.75004	0.80075
¾"-14	L_1	.3390	.98887	1.02930	1.00811	.96768	.92725	.94844	.....
	L_7, plug	.6961	.....	.....	.99607	.94536	.....	.....	.....
	L_8, ring	.6961	.....	.....	.....	.....	.....	.96047	1.01119
1"-11½	L_1	.4000	1.23863	1.28785	1.26285	1.21363	1.16441	1.18941	.....
	L_7, plug	.8348	.....	.....	1.24906	1.18646	.....	.....	.....
	L_8, ring	.8348	.....	.....	.....	.....	.....	1.20320	1.26580

NOTE.—The gage tolerances given in table 63, p. 128, are applicable to these gages.

TABLE 87B.—*Dimensions of plain taper plug gages for gas cylinder neck connections*

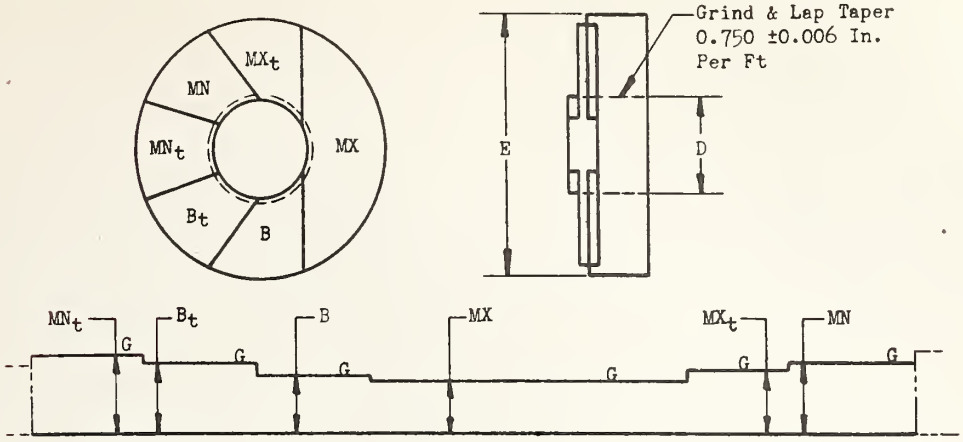


DEVELOPMENT — COUNTER CLOCKWISE

Size	Diameter at basic notch, K_1	Basic length, $B = L_1$	$B_t = B+$	$MN = B-$	$MN_t = B+$	$MX = B+$	$MX_t = B+$	Depth of notch, F	
								Maximum	Minimum
1	2	3	4	5	6	7	8	9	10
	Inches	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
½" - 14	0.7213	0.3200	0.1029	0.0714	0.0314	0.0714	0.1743	0.062	0.057
¾" - 14	.9317	.3390	.1029	.0714	.0314	.0714	.1743	.125	.120
1" - 11½	1.1691	.4000	.1113	.0870	.0243	.0870	.1983	.125	.120
Tolerance	+0.0002 -.0000	±0.0015	+0.000 -0.002	±0.0015	+0.000 -.002	±0.0015	+0.000 -.002	.....	.....

NOTE.—Notches corresponding to columns 4, 5, 6, 7, and 8 shall be located from basic notch, *B*, and tolerances are applicable to step values which are tabulated.

TABLE 87C.—*Dimensions of plain taper ring gages for gas cylinder neck connections*



DEVELOPMENT COUNTER CLOCK WISE

Size	Diameter at basic notch D_0	Basic length, $B = L_1$	$B_t = B+$	$MN = B+$	$MN_t = B+$	$MX = B-$	$MX_t = B+$	Ring diameter, E
1	2	3	4	5	6	7	8	9
	Inches	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*
½" - 14	0.8156	0.3200	0.1029	0.0714	0.1743	0.0714	0.0314	2
¾" - 14	1.0248	.3390	.1029	.0714	.1743	.0714	.0314	2¼
1" - 11½	1.2832	.4000	.1113	.0870	.1983	.0870	.0243	2⅝
Tolerance	+0.0000 -.0002	±0.0015	+0.000 -.002	±0.0015	+0.000 -.002	±0.0015	+0.000 -.002	.....

NOTE.—Notches corresponding to columns 4, 5, 6, 7, and 8 shall be located from basic notch, B, and tolerances are applicable to step values which are tabulated.

2. HOSE CONNECTIONS FOR WELDING AND CUTTING TORCHES

Specifications covering hose connections for welding and cutting torches were formulated and adopted in 1925 by the International Acetylene Association, the Gas Products Association, and various manufacturers. Essentially the same specifications were adopted by the National Screw Thread Commission in 1926.

Revised specifications for these connections were adopted by the International Acetylene Association, March 9, 1939. These revised specifications were adopted by the Interdepartmental Screw Thread Committee and are presented below.

Dimensions essential to the interchangeability of parts have been standardized. Other dimensions and details of design are optional, so that manufacturers may use their own judgment and follow their usual practice as much as possible. Four sizes of connections are specified, as illustrated in table 88.

(a) STANDARD DIMENSIONS

1. Screw threads corresponding to class 3 of the American National fine-thread series are specified, for which dimensions are given in table 24, p. 60. *Right-hand threads are specified for oxygen and left-hand threads for fuel gas.*

2. Angle and outside diameter of internal seat.

3. Radius and distance of radius center of external seat from shank shoulder.

4. Diameter of shank shoulder.

5. Diameter of hole in nut.

6. Large diameter of hose shank.

7. Fuel gas nuts to be designated by annular groove around nuts, cutting corners.

(b) OPTIONAL FEATURES

1. Material of strength equal to or greater than that of free-turning high brass.

2. Diameter of hole through external fitting and gland.

3. Form of end of shank, except seating section as dimensioned.

4. Length of hose shank.

5. Type and number of serrations on hose shank.

6. A second shoulder equal to the large diameter of the largest shank to extend through the hole in the nut for appearance, to be used or omitted for smaller diameter shanks.

7. Length and location of hexagon wrench section on nut.

(c) GAGES

Thread gages[24] for the threads of these connections shall conform to the specifications for gages given in section III.

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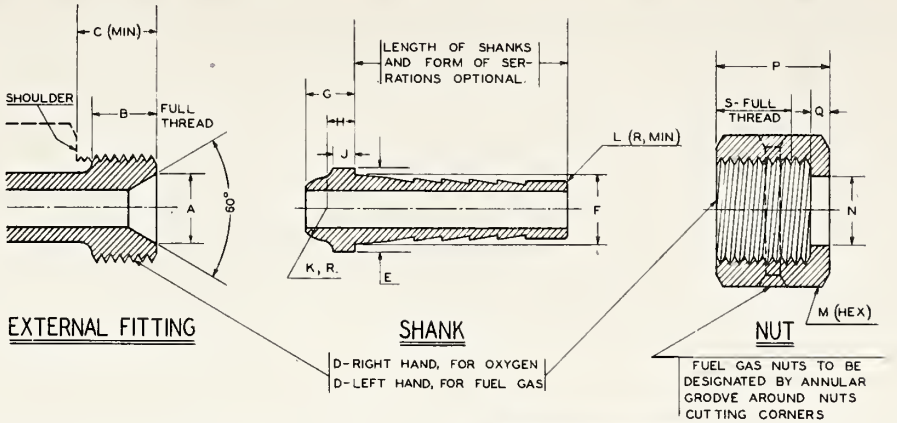
[24] Designs of gages for controlling the other dimensions these connections were published in NBS Miscellaneous Publications M89 and M141, and Handbook H25.

TABLE 88.—*American National standard hose connections for welding and cutting torches, detail dimensions for classes A, B, C, and D*



Class	For hose sizes	External fitting				Shank							Nut				
		A, large diameter of seat	*B*, length of thread	*C*, length to shoulder	*D*, thread size, class 3	*E*, diameter of shoulder	*F*, diameter of shank	*G*, length to shoulder	*H*, radius distance	*J*, length of shoulder	*K*, radius	*L*, radius	*M*, width across flats	*N*, diameter of hole	*P*, length overall	*Q*, length of hole	*S*, depth of full thread
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Inch	*Inch*	*Inch*	*Inch*		*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*	*Inch*	*Inches*	*Inch*	*Inch*
A.....	3/16, 1/8.....	0.250 ±.005	1/4	9/32	3/8-24	0.326 ±.002	0.248 -.005	1/4	0.182 ±.005	1/8	0.099	1/32	7/16	0.257 +.003 -.000	15/32	3/32	1/4
B.....	3/8, 5/16, 1/4, 3/16, 1/8.....	.433 ±.005	5/16	13/32	9/16-18	.498 ±.002	.430 -.005	5/16	.175 ±.005	1/8	.196	3/64	1 1/16	.4375 +.003 -.000	5/8	1/8	5/16
C.....	1/2, 3/8, 5/16, 1/4.....	.625 ±.005	1 1/16	23/32	7/8-14	.750 ±.004	.578 -.010	7/16	.250 ±.005	3/16	.280	1/32	1 1/8	.5937 +.006 -.003	1	5/32	1 1/16
D.....	3/4, 5/8, 1/2, 3/8.....	.954 ±.008	7/8	31/32	1 1/4-12	1.136 ±.004	.875 -.010	5/8	.327 ±.008	3/16	.438	3/64	1 1/2	.9062 +.006 -.002	1 11/32	7/32	15/16

SECTION IX. AMERICAN NATIONAL ROLLED THREADS FOR SCREW SHELLS OF ELECTRIC SOCKETS AND LAMP BASES[25]

The specifications given herein for American National rolled threads for screw shells of electric sockets and lamp bases, with the exception of the more recently adopted intermediate size, were originally published in 1915 in Bulletin No. 1474 of the American Society of Mechanical Engineers entitled "Rolled Threads for Screw Shells of Electric Sockets and Lamp Bases," which was a report of the ASME Committee on Standardization of Special Threads for Fixtures and Fittings.

[25]This standard, in substantially the same form, has been adopted by the American Standards Association. It is published as ASA C44-1931 "Rolled Threads for Screw Shells of Electric Sockets and Lamp Bases" by the ASME, 29 West 39th St., New York 18, N. Y. (35c).

1. FORM OF THREAD

The thread form is composed of two circular segments tangent to each other and of equal radii, as shown in figure 33.

2. THREAD SERIES

The sizes for which standard dimensions and tolerances have been adopted are designated as follows: "Miniature, candelabra, intermediate, medium, and mogul."

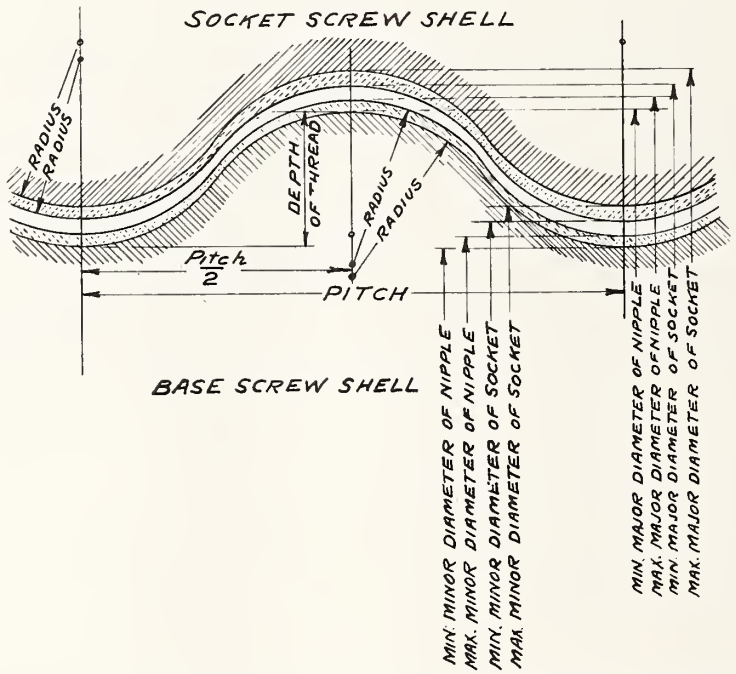


FIGURE 33.—*Illustration of allowance and tolerances, American National rolled threads for screw shells of electric sockets and lamp bases.*

The threads per inch, radii of thread form, and diameter limits for these sizes of lamp base screw shells, which are used on lamp bases, fuse plugs, attachment plugs, and similar devices, are given in table 89.

The corresponding dimensions and limits for socket screw shells, which are used in electric sockets, receptacles, and similar devices, are also given in table 90.

TABLE 89.—*American National rolled threads for lamp base screw shells*

Size	Threads per inch	Pitch	Depth of thread	Radius	Major diameter		Minor diameter	
					Maximum	Minimum	Maximum	Minimum
1	2	3	4	5	6	7	8	9
		Inch	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*
Miniature	14	0.07143	0.020	0.0210	0.375	0.370	0.335	0.330
Candelabra	10	.10000	.025	.0312	.465	.460	.415	.410
Intermediate	9	.11111	.027	.0353	.651	.645	.597	.591
Medium	7	.14286	.033	.0470	1.037	1.031	.971	.965
Mogul	4	.25000	.050	.0906	1.555	1.545	1.455	1.445

TABLE 90.—*American National rolled threads for socket screw shells*

Size	Threads per inch	Pitch	Depth of thread	Radius	Major diameter		Minor diameter	
					Maximum	Minimum	Maximum	Minimum
1	2	3	4	5	6	7	8	9
		Inch	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*
Miniature	14	0.07143	0.020	0.0210	0.3835	0.3775	0.3435	0.3375
Candelabra	10	.10000	.025	.0312	.476	.470	.426	.420
Intermediate	9	.11111	.027	.0353	.664	.657	.610	.603
Medium	7	.14286	.033	.0470	1.053	1.045	.987	.979
Mogul	4	.25000	.050	.0906	1.577	1.565	1.477	1.465

3. GAGES

Gages are necessary to control dimensions in manufacture and to insure interchangeability and proper assembly.

1. GAGING OF LAMP BASE SCREW SHELLS—(*a*) *Working gages.*—For each size of lamp base screw shell there should be provided for control in manufacture, a "go" and a "not go" thread ring gages to govern the minor diameter and thread form, and "go" and "not go" plain ring gages to govern major diameter.

(*b*) *Inspection gages.*—For purposes of inspection in the final acceptance of the product, a "go" thread ring gage governing minor diameter and thread form, and a "not go" plain ring gage governing major diameter are sufficient.

2. GAGING OF SOCKET SCREW SHELLS—(*a*) *Working gages.*—For each size of socket screw shell there should be provided, for control in manufacture, "go" and "not go" thread plug gages to govern the major diameter and thread form, and "go" and "not go" plain plug gages to govern minor diameter.

(*b*) *Inspection gages.*—For the final acceptance of the product, a "go" thread plug gage governing the major diameter and thread form, and a "not go" plain plug gage governing minor diameter are sufficient.

3. TOLERANCES ON GAGES.—Manufacturing tolerances on inspection or working gages shall be as follows:

BASE SCREW SHELL

"Go" thread ring gage, maximum thread size to minus 0.0003 in.

"Not go" thread ring gage, minimum thread size to plus 0.0003 in.

"Go" plain ring gage, maximum major diameter to minus 0.0002 in.

"Not go" plain ring gage, minimum major diameter to plus 0.0002 in.

SOCKET SCREW SHELL

"Go" thread plug gage, minimum thread size to plus 0.0003 in.

"Not go" thread plug gage, maximum thread size to minus 0.0003 in.

"Go" plain plug gage, minimum minor diameter to plus 0.0002 in.

"Not go" plain plug gage, maximum minor diameter to minus 0.0002 in.

CHECK GAGES FOR BASE SCREW SHELL GAGES

Thread check plug for "go" thread ring gage, maximum thread size to minus 0.0003 in.

Thread check plug for "not go" thread ring gage, minimum thread size to plus 0.0003 in.

SECTION X. ACME THREADS[26]

1. GENERAL AND HISTORICAL

When formulated, prior to 1895, Acme screw threads were intended to replace square threads and a variety of threads of other forms used chiefly for the purpose of producing traversing motions on machines, tools, etc. Acme screw threads are now extensively used for a variety of purposes. This standard provides for two general applications of Acme threads, namely, general purpose and centralizing.

The three classes of general purpose threads have clearances on all diameters for free movement and may be used in assemblies with the nut rigidly fixed and movement of the screw in a direction perpendicular to the axis limited by the screw bearing or bearings. The five classes of centralizing threads have a limited clearance at major diameter of screw and nut so that bearing at major diameter maintains approximate alignment of the thread axis and prevents wedging on the flanks of the thread. For any combination of the five classes of screws and nuts covered in this standard some end play or backlash will be obtained. This is unavoidable for interchangeable product. When backlash or end play is objectionable, one of three practices has been used as follows:

(*a*) The nut is split parallel with the axis and adjusted and lapped to fit the screw;

(*b*) The nut is tapped first and the screw is milled, ground, or otherwise machined to fit the nut;

(*c*) The nut is split perpendicular to the axis, and the two parts are adjusted to bear on opposite flanks of the screw thread.

In any case sufficient end play must be left to provide a close running fit.

In addition to limiting dimensions for the standard series of diameters and pitches of Acme threads, tables of pitch diameter tolerances provide for a wide choice of diameters for a given standard pitch, and by use of the formulas for diameter and pitch increments the pitch diameter tolerances for special diameters and pitches can be determined for each of the five classes of screws and nuts. Multiple threads should be considered when fast relative motion is required.

2. SPECIFICATIONS FOR ACME FORM OF THREAD

1. Angle of Thread.—The angle between the sides of the thread measured in an axial plane shall be 29°. The line bisecting this 29° angle shall be perpendicular to the axis of the screw thread.

2. Depth of Thread.—The basic depth of the thread shall be equal to one-half of the pitch.

3. Thickness of Thread.—The basic thickness of the thread at a diameter smaller by one-half the pitch than the basic major diameter shall be equal to one-half of the pitch.

4. Allowance (Minimum Clearance) at Major and Minor Diameters.—(*a*) A minimum diametrical clearance is provided at the minor diameter of all Acme screws by establishing the maximum minor diameter of screws 0.020

[26] This section has been developed in cooperation with the ASA War Standards Committee on Acme threads, and represents the extent of agreement with the Interdepartmental Screw Thread Committee at the time of publication of this handbook. The material on the centralizing fit as published herein is subject to such revision as may be found necessary in the light of experience.

inch below the basic minor diameter on threads 10-pitch and coarser, and 0.010 inch on finer pitches.

A minimum diametrical clearance for the fillet in the screw is provided at the minor diameter of all centralizing threads by establishing the minimum minor diameter of the nut $p/10$ greater than the basic minor diameter.

(*b*) For general purpose threads a diametrical clearance at the major diameter is obtained by establishing the minimum major diameter of the nut 0.020 inch above the basic major diameter for 10-pitch and coarser and 0.010 inch for finer pitches.

(*c*) For centralizing threads the minimum diametrical clearance at the major diameter is obtained by establishing the minimum major diameter of the nut $0.001\sqrt{D}$ above the basic major diameter.

5. Chamfers and Fillets.—Centralizing screws shall, and general purpose screws may, have the crest corners chamfered at an angle of 45° with the axis to a minimum depth of $p/20$ and a maximum depth of $p/15$. This corresponds to a minimum width of chamfer flat of $0.0707p$, and a maximum width of $0.0945p$. (See table 91, columns 8 and 9.)

Centralizing screws for classes 2C, 3C, and 4C may have a fillet at the minor diameter not greater than $0.1p$, and for classes 5C and 6C the minimum fillet shall be $0.07p$, and the maximum $0.1p$.

6. Basic Thread Form Dimensions.—(*a*) *General.*—The basic dimensions of the Acme thread form for the most generally used pitches are given in table 91. The basic thread form is illustrated in figure 34.

(*b*) *Special requirements, deviations from nominal diameter.*—Applications requiring special machining processes resulting in a basic diameter less than the nominal shown in table 92, column 1, shall have allowances and tolerances in accordance with table 93, footnote 1; table 94, columns 1 and 2; and tabulated tolerances, tables 95, 96, and 97. Classes 5C and 6C are particular cases of these requirements.

(*c*) *Special diameters.*—For applications of special diameters not shown in Acme thread tables, the actual basic major diameter in decimals shall be shown on drawings, specifications, and tools.

3. ACME THREAD SERIES

There has been selected a series of diameters and associated pitches of Acme threads listed in table 92, which are recommended as preferred. These diameters and pitches have been carefully selected to meet the present needs with the fewest number of items, in order to reduce to a minimum the inventory of both tools and gages.

4. CLASSIFICATION AND TOLERANCES, ACME THREADS

There are established herein three classes of screws and nuts for general purpose and five classes for centralizing Acme threads, as follows (see symbols, p. 161):

Type of thread	Class of thread				
General purpose	2G	3G	4G	....	.....
Centralizing	2C	3C	4C	5C	6C

These classes, together with the accompanying specifications, are for the purpose of assuring the interchangeable manufacture of Acme threaded parts. Each user is free to select the classes best adapted to his particular needs. It is suggested that a class 2 nut be used with a class 2 screw for either general purpose or centralizing assemblies. If less backlash or end play is desired, classes 3 and 4 are provided for both general purpose or centralizing threads, and classes 5C and 6C, for centralizing threads only. All classes of general purpose screws and nuts may be used interchangeably. The requirement for a centralizing fit is that the sum of the major diameter tolerance on the nut, and the major diameter tolerance plus the major diameter allowance on the screw shall equal or be less than the pitch diameter allowance on the screw. A class 2C screw, which has a larger pitch diameter allowance than either a class 3C or 4C screw, can be used interchangeably with classes 2C, 3C, and 4C nuts and fulfill this requirement. Similarly, a class 3C screw can be used interchangeably with classes 3C and 4C nuts, but only a class 4C nut can be used with a class 4C screw. A class 5C screw can be used

interchangeably with classes 5C and 6C nuts. A class 6C screw can be used with either a 5C or 6C nut but when a 5C nut is used with a 6C screw the minimum backlash may be less than that prescribed for these classes.

1. Basic Diameters.—The maximum major diameter of the screw is the nominal major diameter of all classes except 5C and 6C. The maximum major diameter of all class 5C and 6C screws is the basic major diameter, B, established by subtracting $0.025\sqrt{D}$ from the nominal diameter, D. The minimum pitch diameter of the nut is basic and equal to the basic major diameter minus the basic depth of thread, $p/2$. The basic minor diameter is equal to the basic major diameter minus twice the basic thread depth, p. The minimum minor diameter of the general purpose nut is basic. The minimum minor diameter of the centralizing nut is $p/10$ above basic.

2. Length of Engagement.—The tolerances specified herein are applicable to lengths of engagement not exceeding twice the nominal major diameter.

3. Tolerances.—(*a*) The tolerances specified represent the extreme variations allowed on the product. They are such as to produce interchangeability and maintain a high grade of product.

(*b*) The tolerances on diameters of the nuts or threaded holes are plus, and are applied from the minimum nut sizes to above the minimum nut sizes.

(*c*) The tolerances on diameters of the screws are minus, and are applied from the maximum screw sizes to below the maximum screw sizes.

(*d*) The pitch diameter (or thread thickness) tolerances for a screw or nut of a given class are the same.

(*e*) The pitch diameter (or thread thickness) tolerances for the product include lead and angle errors.

(*f*) The tolerances on the major and minor diameters of screws and nuts are listed in table 93 and are based on the following formulas:

Tolerance on major and minor diameters of screw and nut

Type of thread	Major diameter		Minor diameter	
	Screw	Nut	Screw	Nut
General purpose....	$0.05p$	0.020 in. for 10-pitch and coarser; 0.010 in. for finer pitches	1.5 × pitch diameter tolerance	$0.05p$
Centralizing. Class 2C..	$0.0035\sqrt{D}$	$0.0035\sqrt{D}$	1.5 × pitch diameter tolerance	$0.05p$
Centralizing. Classes 3C and 5C...	$.0015\sqrt{D}$	$.0035\sqrt{D}$		
Centralizing. Classes 4C and 6C...	$.0010\sqrt{D}$	$.0020\sqrt{D}$		

(*a*) Pitch diameter tolerances for classes 2, 3 and 5, and 4 and 6, and for various practicable combinations of diameter and pitch, are given in tables 95, 96, and 97. The ratios of the pitch diameter tolerances of classes 2, 3 and 5, and 4 and 6, are 3.0, 1.4, and 1, respectively. The pitch diameter tolerance for classes 4 and 6 is $0.010\sqrt{p} + 0.002\sqrt{D}$, where D is the nominal major diameter.

4. Allowances.—Allowances applied to the pitch diameter of the screw for all classes, general purpose and centralizing, are given in table 94. These pitch diameter allowances are equal to the sum of the allowance on major diameter, column 8, table 93, and the sum of the tolerances on screw and nut, columns 9 to 13, inclusive, table 93, for general purpose and centralizing, plus an additional amount of $0.002\sqrt{D}$ inches for classes 5C and 6C. This is the minimum pitch diameter allowance that is required to maintain the centralizing fit and minimum end play of $0.0005\sqrt{D}$ inch for classes 5C and 6C.

For centralizing fits, when the product has a length of engagement greater than the standard length of the thread ring gage as shown in table 101, column 3, and lead errors not exceeding the values shown at the bottom of that table, and when "go" thread ring gages of these lengths are to be used, the maximum pitch diameter of the

screw shall be decreased by the amount shown in table 101, column 5. If the lead errors in the product are greater than indicated, the allowance for the ring gage stated in column 5 should be increased proportionately. However, if methods of gaging the screw are to be used which will detect angle error and cumulative lead error, the pitch diameter of the screw shall be below the tabular maximum pitch diameter of the screw an amount sufficient to compensate for the measured errors.

An increase of 10 percent in the allowance is recommended for each inch, or fraction thereof, that the length of engagement exceeds two diameters.

5. Formulas for Centralizing Acme Threads, Classes 5 and 6.—The formulas for allowances and tolerances for centralizing Acme threads, classes 5 and 6, are as follows:

Nominal diameter $= D$

Basic major diameter, B $\begin{cases} = \text{maximum major diameter of screw} \\ = D - 0.025\sqrt{D}. \end{cases}$

Tolerance on major diameter $= \begin{cases} \text{class 5..} \begin{cases} \text{screw} = 0.0015\sqrt{D}. \\ \text{nut} = 0.0035\sqrt{D}. \end{cases} \\ \text{class 6..} \begin{cases} \text{screw} = 0.0010\sqrt{D}. \\ \text{nut} = 0.0020\sqrt{D}. \end{cases} \end{cases}$

Minimum major diameter of nut $= B + 0.001\sqrt{D}.$

Basic minor diameter $= B - p.$

Minimum minor diameter of nut = basic minor diameter $+ 0.1p.$

Tolerance on minor diameter of nut $= 0.05p.$

Maximum minor diameter of screw = basic minor diameter minus 0.020 inch for 10-pitch and coarser, and minus 0.010 inch for finer threads.

Tolerance on minor diameter of screw = 1.5 pitch diameter tolerance.

Minimum pitch diameter of nut $\begin{cases} = \text{basic pitch diameter.} \\ = B - 0.5p. \end{cases}$

Maximum pitch diameter of screw = basic pitch diameter minus pitch diameter allowance.

Pitch diameter allowance, class 5 $= 0.008\sqrt{D}.$

Pitch diameter allowance, class 6 $= 0.006\sqrt{D}.$

Pitch diameter tolerance, class 5 $= 0.014\sqrt{p} + 0.0028\sqrt{D}.$

Pitch diameter tolerance, class 6 $= 0.010\sqrt{p} + 0.0020\sqrt{D}.$

5. LIMITING DIMENSIONS, ACME THREADS

Limiting dimensions for *general purpose* Acme threads of the preferred series of diameters and pitches are given in table 98. The application of these limits is illustrated in figure 35.

Limiting dimensions for centralizing Acme threads of the preferred series of diameters and pitches are given in tables 99 and 99(A). The application of these limits is illustrated in figures 36 and 36(A).

6. SYMBOLS

The symbols given below are recommended for use on drawings and in specifications, and on tools and gages:

D = nominal diameter
BD = basic diameter
p = pitch
L = lead
NA = Acme threads
G = General purpose
C = Centralizing
LH = left hand

Examples of designations:

$1\frac{3}{4}$-6*NA*-2*G* = General purpose class 2 Acme threads; major diameter $1\frac{3}{4}$ inch, pitch 0.1667 inch, single, right hand.

$1\frac{3}{4}$-6*NA*-4*C* = Centralizing class 4 Acme thread; major diameter $1\frac{3}{4}$ inch, pitch 0.1667 inch, single, right hand.

$2\frac{7}{8}$-0.4*p*-0.8*L*-*NA*-3*G* = General purpose class 3 Acme thread; major diameter $2\frac{7}{8}$ inch, pitch 0.4 inch, lead 0.8 inch, double, right hand.

$2\frac{7}{8}$-0.4*p*-0.8*L*-*NA*-3*C* = Centralizing class 3 Acme thread; major diameter $2\frac{7}{8}$ inch, pitch 0.4 inch, lead 0.8 inch, double, right hand.

$2\frac{1}{2}$-0.3333*p*-0.6667*L*-*NA*-5*C* = Centralizing class 5 Acme thread; nominal major diameter $2\frac{1}{2}$ inches (basic major diameter 2.4605 inches), pitch 0.3333 inch, lead 0.6667 inch, double, right hand.

$1\frac{3}{4}$-6*NA*-2*G*-*LH*
$1\frac{3}{4}$-6*NA*-4*C*-*LH*
$2\frac{7}{8}$-0.4*p*-0.8*L*-NA-3*G*-*LH*
$2\frac{7}{8}$-0.4*p*-0.8*L*-*NA*-3*C*-*LH*
$2\frac{1}{2}$-0.3333*p*-0.6667*L*-*NA*-5*C*-*LH*

} Left-hand Acme threads.

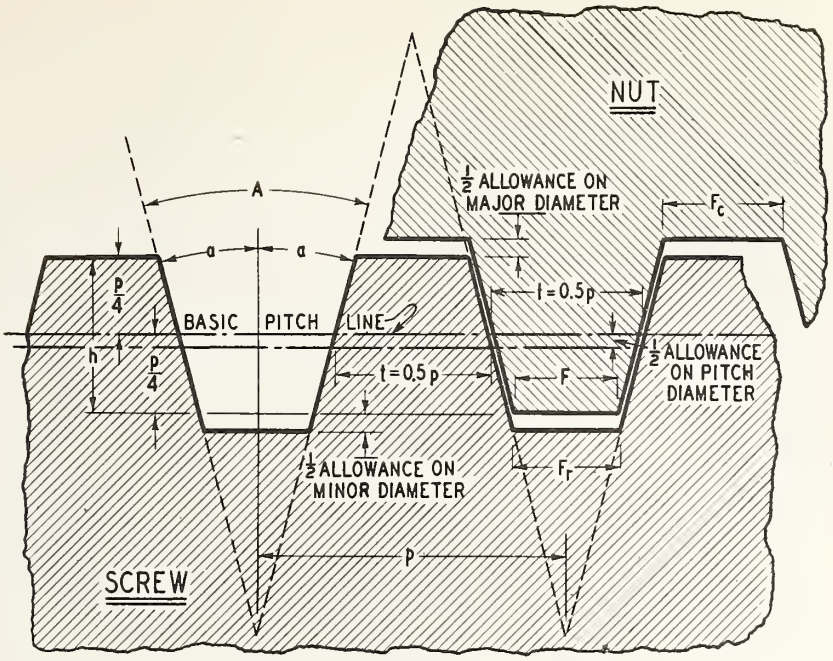


FIGURE 34.—*Acme form of thread.*

NOTATION

$A = 29^{\circ}00'$
$a = 14^{\circ}30'$
p = pitch
n = number of threads per inch
N = number of turns per inch
$h = 0.5p$, basic depth of thread
t = thickness of thread
$F = 0.3707p$ = basic width of flat
$F_c = 0.3707p - 0.259 \times$ major diameter allowance
$F_r = 0.3707p - 0.259 \times$ (minor diameter allowance on screw − pitch diameter allowance).

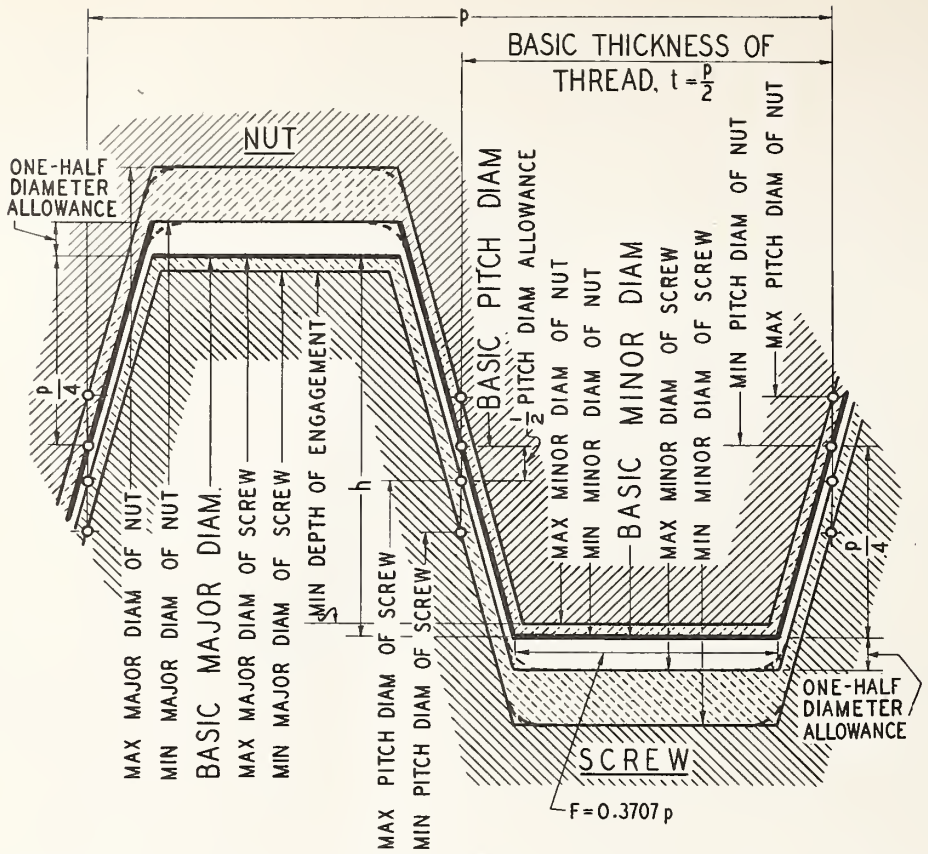


FIGURE 35.—*Illustration of allowances, tolerances, and crest clearances, general purpose Acme threads.*

NOTATION

p = pitch
h = basic thread depth
Heavy lines show basic size.

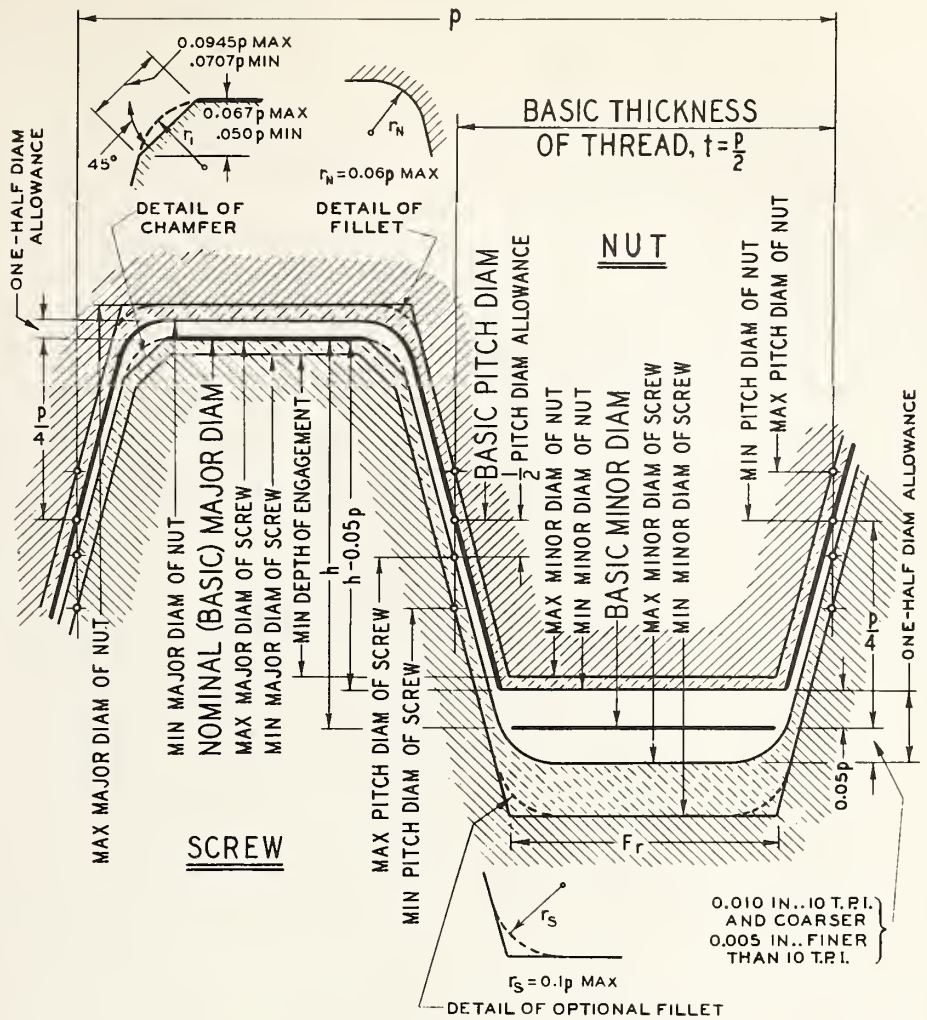


FIGURE 36.—*Illustration of allowances, tolerances, and crest clearances, centralizing Acme threads, classes 3 and 4.*

NOTATION

p = pitch
h = basic thread depth
Heavy lines show basic size.

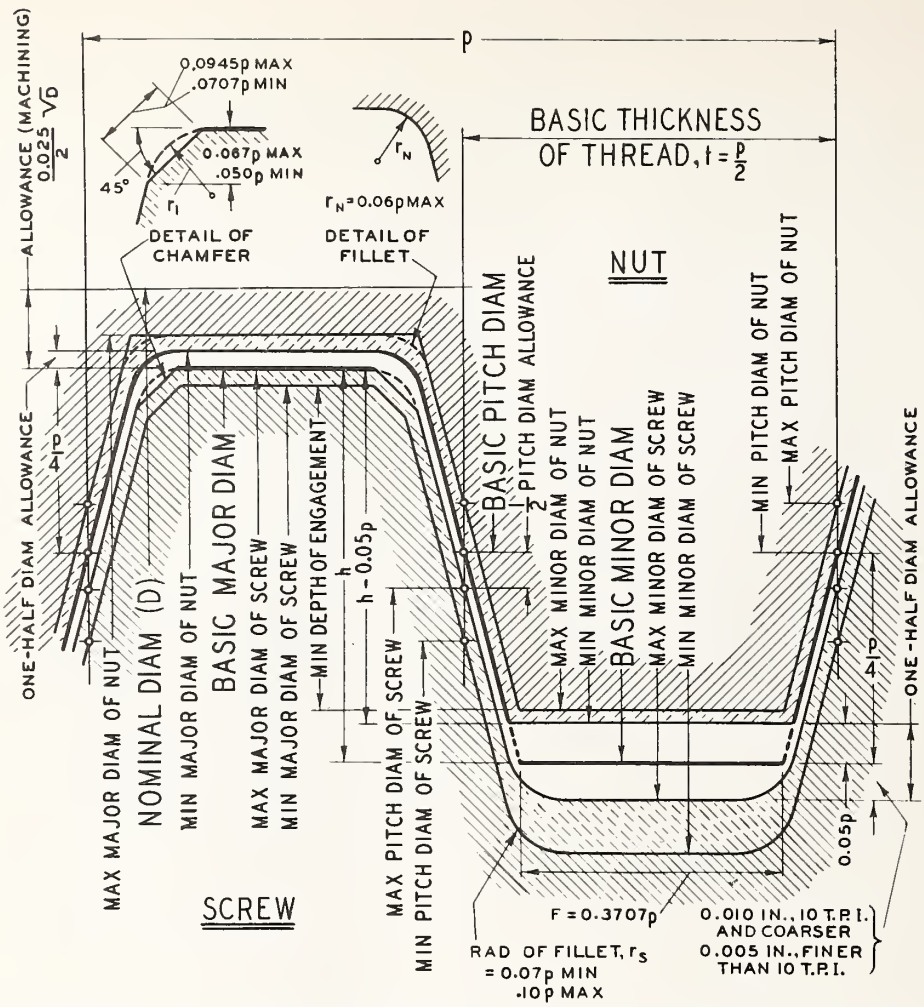


FIGURE 36 (A).—*Illustration of allowances, tolerances, and crest clearances, centralizing Acme threads, classes 5 and 6.*

NOTATION

p = pitch
h = basic thread depth
Heavy lines show basic form.

TABLE 91.—*Acme thread form, basic dimensions*

Threads per inch	Pitch, p	Depth of thread (basic) $h = 0.5p$	Total depth of thread, (all screws)	Thread thickness (basic), t	Width of flat at—		45° chamfer, crest of centralizing screws		Maximum fillet radius, root of centralizing tapped hole, $0.06p$	Fillet radius at minor diameter of centralizing screws	
					Crest of nut (basic), $F = 0.3707p$	Root of nut[1], $F_c = 0.3707p - 0.259 \times$ allowance	Minimum depth, $0.05p$	Minimum width of flat, $0.0707p$		Minimum, classes 5 and 6 only, $0.07p$	Maximum, all classes, $0.10p$
1	2	3	4	5	6	7	8	9	10	11	12
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
16	0.06250	0.03125	0.0362	0.03125	0.0232	0.0206	0.0031	0.0044	0.004	0.0044	0.0062
14	.07143	.03571	.0407	.03571	.0265	.0239	.0036	.005	.004	.0050	.0071
12	.08333	.04167	.0467	.04167	.0309	.0283	.0042	.006	.005	.0058	.0083
10	.10000	.05000	.0600	.05000	.0371	.0319	.0050	.007	.006	.0070	.0100
8	.12500	.06250	.0725	.06250	.0463	.0411	.0062	.009	.0075	.0088	.0125
6	.16667	.08333	.0933	.08333	.0618	.0566	.0083	.012	.010	.0117	.0167
5	.20000	.10000	.1100	.10000	.0741	.0689	.0100	.014	.012	.0140	.0200
4	.25000	.12500	.1350	.12500	.0927	.0875	.0125	.018	.015	.0175	.0250
3	.33333	.16667	.1767	.16667	.1236	.1184	.0167	.024	.020	.0233	.0333
2½	.40000	.20000	.2100	.20000	.1483	.1431	.020	.028	.024	.0280	.0400
2	.50000	.25000	.2600	.25000	.1853	.1802	.025	.035	.030	.0350	.0500
1½	.66667	.33333	.3433	.33333	.2471	.2419	.033	.047	.040	.0467	.0667
1⅓	.75000	.37500	.3850	.37500	.2780	.2728	.038	.053	.045	.0525	.0750
1	1.00000	.50000	.5100	.50000	.3707	.3655	.050	.071	.060	.0700	.1000

[1] Values tabulated in column 7 are for the general purpose nut only. The basic width of flat at the root of the screw, F_r, is equal to value for F_c in column 7, minus 0.259 times the pitch diameter allowance.

TABLE 92.—*Acme thread series*

Identification		Basic diameters						Thread data					
		General purpose and centralizing, classes 2, 3, and 4			Centralizing, classes 5 and 6							Helix angle at basic pitch diameter	
Nominal sizes (all classes)	Threads per inch	Major diameter, D	Pitch diameter, E	Minor diameter, K	Major diameter, B	Pitch diameter, E	Minor diameter, K	Pitch, p	Thread thickness at pitch line, t	Basic depth of thread, $h = 0.5p$	Basic width of flat, $F = 0.3707p$	General purpose and centralizing, classes 2, 3, and 4, s	Centralizing, classes 5 and 6, s
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Inches		*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Deg.* *Min.*	*Deg.* *Min.*
¼	16	0.2500	0.2188	0.1875	.....	.....	.....	0.06250	0.03125	0.03125	0.0232	5 12	.....
5/16	14	.3125	.2768	.2411	.....	.....	.....	.07143	.03571	.03571	.0265	4 42	.....
⅜	12	.3750	.3333	.2917	.....	.....	.....	.08333	.04167	.04167	.0309	4 33	.....
7/16	12	.4375	.3958	.3542	.....	.....	.....	.08333	.04167	.04167	.0309	3 50	.....
½	10	.5000	.4500	.4000	.4823	.4323	.3823	.10000	.05000	.05000	.0371	4 3	4 13
⅝	8	.6250	.5625	.5000	.6052	.5427	.4802	.12500	.06250	.06250	.0463	4 3	4 12
¾	6	.7500	.6667	.5833	.7284	.6451	.5617	.16667	.08333	.08333	.0618	4 33	4 42
⅞	6	.8750	.7917	.7083	.8516	.7683	.6849	.16667	.08333	.08333	.0618	3 50	3 57
1	5	1.0000	.9000	.8000	.9750	.8750	.7750	.20000	.10000	.10000	.0741	4 3	4 10
1⅛	5	1.1250	1.0250	.9250	1.0985	.9985	.8985	.20000	.10000	.10000	.0741	3 33	3 39
1¼	5	1.2500	1.1500	1.0500	1.2220	1.1220	1.0220	.20000	.10000	.10000	.0741	3 10	3 15
1⅜	4	1.3750	1.2500	1.1250	1.3457	1.2207	1.0957	.25000	.12500	.12500	.0927	3 39	3 44
1½	4	1.5000	1.3750	1.2500	1.4694	1.3444	1.2194	.25000	.12500	.12500	.0927	3 19	3 23
1¾	4	1.7500	1.6250	1.5000	1.7169	1.5919	1.4669	.25000	.12500	.12500	.0927	2 48	2 52
2	4	2.0000	1.8750	1.7500	1.9646	1.8396	1.7146	.25000	.12500	.12500	.0927	2 26	2 29
2¼	3	2.2500	2.0833	1.9167	2.2125	2.0458	1.8792	.33333	.16667	.16667	.1236	2 55	2 58
2½	3	2.5000	2.3333	2.1667	2.4605	2.2938	2.1272	.33333	.16667	.16667	.1236	2 36	2 39
2¾	3	2.7500	2.5833	2.4167	2.7085	2.5418	2.3752	.33333	.16667	.16667	.1236	2 21	2 23
3	2	3.0000	2.7500	2.5000	2.9567	2.7067	2.4567	.50000	.25000	.25000	.1853	3 19	3 22
4	2	4.0000	3.7500	3.5000	3.9500	3.7000	3.4500	.50000	.25000	.25000	.1853	2 26	2 28
5	2	5.0000	4.7500	4.5000	4.9441	4.6941	4.4441	.50000	.25000	.25000	.1853	1 55	1 56

TABLE 93. — *Tolerances and allowances (minimum clearances) at major and minor diameters, Acme thread series (max major diameter of screw, D, basic. Basic thread depth, h = 0.5p.)*

Size[1]	Threads per inch	Allowances from basic major and minor diameters, all classes			Tolerance on minor diameter, all nuts, 0.05p	Tolerance on major diameter, screw and nut (plus on nut, minus on screw)						
		Minor diameter all screws, minus; major diameter general purpose nut, plus	Centralizing nut			General purpose, all classes		Centralizing				
								Class 2C	Classes 3C and 5C		Classes 4C and 6C	
			Major diameter, plus $0.0010\sqrt{D}$	Minor diameter[2], plus 0.1p		Screw, 0.05p	Nut, (same as col. 3)	Screw and nut, $0.0035\sqrt{D}$	Screw, $0.0015\sqrt{D}$	Nut, $0.0035\sqrt{D}$	Screw, $0.0010\sqrt{D}$	Nut, $0.0020\sqrt{D}$
1	2	3	4	5	6	7	8	9	10	11	12	13
Inches		*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
1/4....	16	0.010	.....	.....	0.0031	0.0031	0.010	.....	.....	.....	.....	.....
5/16...	14	.010	.....	.....	.0036	.0036	0.010	.....	.....	.....	.....	.....
3/8....	12	.010	.....	.....	.0042	.0042	.010	.....	.....	.....	.....	.....
7/16...	12	.010	.....	.....	.0042	.0042	.010	.....	.....	.....	.....	.....
1/2....	10	.020	0.0007	0.0100	.0050	.0050	.020	0.0025	0.0011	0.0025	0.0007	0.0014
5/8....	8	.020	.0008	.0125	.0062	.0062	.020	.0028	.0012	.0028	.0008	.0016
3/4....	6	.020	.0009	.0167	.0083	.0083	.020	.0030	.0013	.0030	.0009	.0017
7/8....	6	.020	.0009	.0167	.0083	.0083	.020	.0033	.0014	.0033	.0009	.0019
1.....	5	.020	.0010	.0200	.0100	.0100	.020	.0035	.0015	.0035	.0010	.0020
1 1/8....	5	.020	.0011	.0200	.0100	.0100	.020	.0037	.0016	.0037	.0011	.0021
1 1/4....	5	.020	.0011	.0200	.0100	.0100	.020	.0039	.0017	.0039	.0011	.0022
1 3/8....	4	.020	.0012	.0250	.0125	.0125	.020	.0041	.0018	.0041	.0012	.0023
1 1/2....	4	.020	.0012	.0250	.0125	.0125	.020	.0043	.0018	.0043	.0012	.0024
1 3/4....	4	.020	.0013	.0250	.0125	.0125	.020	.0046	.0020	.0046	.0013	.0026
2.....	4	.020	.0014	.0250	.0125	.0125	.020	.0049	.0021	.0049	.0014	.0028
2 1/4....	3	.020	.0015	.0333	.0167	.0167	.020	.0052	.0022	.0052	.0015	.0030
2 1/2....	3	.020	.0016	.0333	.0167	.0167	.020	.0055	.0024	.0055	.0016	.0032
2 3/4....	3	.020	.0017	.0333	.0167	.0167	.020	.0058	.0025	.0058	.0017	.0033
3.....	2	.020	.0017	.0500	.0250	.0250	.020	.0061	.0026	.0061	.0017	.0035
4.....	2	.020	.0020	.0500	.0250	.0250	.020	.0070	.0030	.0070	.0020	.0040
5.....	2	.020	.0022	.0500	.0250	.0250	.020	.0078	.0034	.0078	.0022	.0045

[1] For an intermediate size, the tolerances and allowances (minimum clearances) for the next larger size shall apply.
[2] The minimum clearance at the minor diameter between the centralizing screw and nut is the sum of columns 3 and 5.

NOTE. — Tolerance on minor diameter of all screws is 1.5 × pitch diameter tolerance. The maximum angular play of a centralizing nut, 1 diameter long, on its screw for the maximum major diameter clearance is 1° or less.

TABLE 94.—*Pitch diameter allowances for Acme threads*

Nominal size range		Pitch diameter allowances on screws[1]		
Above—	To and including—	Classes 2 and 5C, $0.008\sqrt{D}$	Classes 3 and 6C, $0.006\sqrt{D}$	Class 4, $0.004\sqrt{D}$
1	2	3	4	5
Inches	*Inches*	*Inch*	*Inch*	*Inch*
0	3/16	0.0024	0.0018	0.0012
3/16	5/16	.0040	.0030	.0020
5/16	7/16	.0049	.0037	.0024
7/16	9/16	.0057	.0042	.0028
9/16	11/16	.0063	.0047	.0032
11/16	13/16	.0069	.0052	.0035
13/16	15/16	.0075	.0056	.0037
15/16	1 1/16	.0080	.0060	.0040
1 1/16	1 3/16	.0085	.0064	.0042
1 3/16	1 5/16	.0089	.0067	.0045
1 5/16	1 7/16	.0094	.0070	.0047
1 7/16	1 9/16	.0098	.0073	.0049
1 9/16	1 7/8	.0105	.0079	.0052
1 7/8	2 1/8	.0113	.0085	.0057
2 1/8	2 3/8	.0120	.0090	.0060
2 3/8	2 5/8	.0126	.0095	.0063
2 5/8	2 7/8	.0133	.0099	.0066
2 7/8	3 1/4	.0140	.0105	.0070
3 1/4	3 3/4	.0150	.0112	.0075
3 3/4	4 1/4	.0160	.0120	.0080
4 1/4	4 3/4	.0170	.0127	.0085
4 3/4	5 1/2	.0181	.0136	.0091

[1] An increase of 10 percent in the allowance is recommended for each inch, or fraction thereof, that the length of engagement exceeds 2 diameters. The values in columns 3, 4, and 5 are to be used for any size within the corresponding range in columns 1 and 2. These values are calculated from the mean of columns 1 and 2.

TABLE 95.—*Pitch diameter tolerances for Acme screw threads, class 2*

Threads per inch, n	Pitch increment, $0.030\sqrt{1/n}$	Pitch diameter tolerances[1] for nominal diameters up to and including—										
		1/4 in.	5/16 in.	3/8 in.	7/16 in.	1/2 in.	5/8 in.	3/4 in.	7/8 in.	1 in.	1 1/8 in.	1 1/4 in.
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
16.....	0.00750	0.0105	0.0109	0.0112	0.0115	0.0117	0.0122	0.0127	.....	.....	.....	.....
14.....	.00802	.....	.0114	.0117	.0120	.0123	.0128	.0132	0.0136	0.0140	.....	.....
12.....	.00866	.....	.....	.0123	.0126	.0129	.0134	.0139	.0143	.0147	0.0150	0.0154
10.....	.00949	.....	.....	.0132	.0135	.0137	.0142	.0147	.0151	.0155	.0158	.0162
8.....	.01061	.....	.....	.....	.....	.0148	.0154	.0158	.0162	.0166	.0170	.0173
6.....	.01225	.....	.....	.....	.....	.....	.....	.0174	.0179	.0182	.0186	.0190
5.....	.01342	.....	.....	.....	.....	.....	.....	.....	.0190	.0194	.0198	.0201
4.....	.01500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.0214	.0217
3.....	.01732	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2 1/2.....	.01897	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2.....	.02121	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1 1/2.....	.02449	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1 1/3.....	.02598	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1.....	.03000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Diameter increment, $0.006\sqrt{D}$.....		0.00300	0.00335	0.00367	0.00397	0.00424	0.00474	0.00520	0.00561	0.00600	0.00636	0.00671

Threads per inch, n	Pitch increment, $0.030\sqrt{1/n}$	Pitch diameter tolerances[1] for nominal diameters up to and including—									
		1 3/8 in.	1 1/2 in.	1 3/4 in.	2 in.	2 1/4 in.	2 1/2 in.	2 3/4 in.	3 in.	4 in.	5 in.
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
16.....	0.00750	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14.....	.00802	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12.....	.00866	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10.....	.00949	0.0165	0.0168	0.0174	.....	.....	.....	.....	.....	.....	.....
8.....	.01061	.0176	.0180	.0185	0.0191	.....	.....	.....	.....	.....	.....
6.....	.01225	.0193	.0196	.0202	.0207	0.0212	.....	.....	.....	.....	.....
5.....	.01342	.0205	.0208	.0214	.0219	.0224	0.0229	.....	.....	.....	.....
4.....	.01500	.0220	.0223	.0229	.0235	.0240	.0245	0.0249	0.0254	0.0270	.....
3.....	.01732	.....	.0247	.0253	.0258	.0263	.0268	.0273	.0277	.0293	0.0307
2 1/2.....	.01897	.....	.....	.0269	.0275	.0280	.0285	.0289	.0294	.0310	.0324
2.....	.02121	.....	.....	.....	.0297	.0302	.0307	.0312	.0316	.0332	.0346
1 1/2.....	.02449	.....	.....	.....	.....	.....	.....	.....	.0349	.0365	.0379
1 1/3.....	.02598	.....	.....	.....	.....	.....	.....	.....	.0364	.0380	.0394
1.....	.03000	.....	.....	.....	.....	.....	.....	.....	.....	.0420	.0434
Diameter increment, $0.006\sqrt{D}$.....		0.00704	0.00735	0.00794	0.00849	0.00900	0.00949	0.00995	0.01039	0.01200	0.01342

[1] See footnotes, table 97.

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TABLE 96.—*Pitch diameter tolerances for Acme screw threads, classes 3 and 5*

Threads per inch, n	Pitch increment, $0.014\sqrt{\frac{1}{n}}$	Pitch diameter tolerances[1] for nominal diameters up to and including—										
		¼ in.	5/16 in.	⅜ in.	7/16 in.	½ in.	5/8 in.	¾ in.	⅞ in.	1 in.	1⅛ in.	1¼ in.
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
16.....	0.00350	0.0049	0.0051	0.0052	0.0054	0.0055	0.0057	0.0059	.....	.....	.....	.....
14.....	.00374	.....	.0053	.0055	.0056	.0057	.0060	.0062	0.0064	0.0065	.....	.....
12.....	.00404	.....	.....	.0058	.0059	.0060	.0062	.0065	.0067	.0068	0.0070	0.0072
10.....	.00443	.....	.....	.0061	.0063	.0064	.0066	.0068	.0070	.0072	.0074	.0076
8.....	.00495	.....	.....	.....	.....	.0069	.0072	.0074	.0076	.0078	.0079	.0081
6.....	.00572	.....	.....	.....	.....	.....	.....	.0081	.0083	.0085	.0087	.0088
5.....	.00626	.....	.....	.....	.....	.....	.....	.....	.0089	.0091	.0092	.0094
4.....	.00700	.....	.....	.....	.....	.....	.....	.....	.....	.....	.0100	.0101
3.....	.00808	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2½.....	.00885	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2.....	.00990	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1½.....	.01143	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1⅓.....	.01212	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1.....	.01400	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Diameter increment, $0.0028\sqrt{D}$.....		0.00140	0.00157	0.00171	0.00185	0.00198	0.00221	0.00242	0.00262	0.00280	0.00297	0.00313

Threads per inch, n	Pitch increment, $0.014\sqrt{\frac{1}{n}}$	Pitch diameter tolerances[1] for nominal diameters up to and including—									
		1⅜ in.	1½ in.	1¾ in.	2 in.	2¼ in.	2½ in.	2¾ in.	3 in.	4 in.	5 in.
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
16.....	0.00350	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14.....	.00374	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12.....	.00404	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10.....	.00443	0.0077	0.0079	0.0081	.....	.....	.....	.....	.....	.....	.....
8.....	.00495	.0082	.0084	.0086	0.0089	.....	.....	.....	.....	.....	.....
6.....	.00572	.0090	.0091	.0094	.0097	0.0099	.....	.....	.....	.....	.....
5.....	.00626	.0095	.0097	.0100	.0102	.0104	0.0107	.....	.....	.....	.....
4.....	.00700	.0103	.0104	.0107	.0110	.0112	.0114	0.0116	0.0118	0.0126	.....
3.....	.00808	.....	.0115	.0118	.0120	.0123	.0125	.0127	.0129	.0137	0.0143
2½.....	.00885	.....	.....	.0126	.0128	.0131	.0133	.0135	.0137	.0145	.0151
2.....	.00990	.....	.....	.....	.0139	.0141	.0143	.0145	.0147	.0155	.0162
1½.....	.01143	.....	.....	.....	.....	.....	.....	.....	.0163	.0170	.0177
1⅓.....	.01212	.....	.....	.....	.....	.....	.....	.....	.0170	.0177	.0184
1.....	.01400	.....	.....	.....	.....	.....	.....	.....	.....	.0196	.0203
Diameter increment, $0.0028\sqrt{D}$.....		0.00328	0.00343	0.00370	0.00396	0.00420	0.00443	0.00464	0.00485	0.00560	0.00626

[1] See footnotes, table 97.

TABLE 97.—*Pitch diameter tolerances for Acme screw threads, classes 4 and 6*

Threads per inch, n	Pitch increment, $0.010\sqrt{1/n}$	Pitch diameter tolerances[1] for nominal diameters up to and including—										
		¼ in.	5/16 in.	⅜ in.	7/16 in.	½ in.	⅝ in.	¾ in.	⅞ in.	1 in.	1⅛ in.	1¼ in.
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
16.....	0.00250	0.0035	0.0036	0.0037	0.0038	0.0039	0.0041	0.0042	.....	.....	.....	.....
14.....	.00267	.....	.0038	.0039	.0040	.0041	.0042	.0044	0.0045	0.0047	.....	.....
12.....	.00289	.....	.....	.0041	.0042	.0043	.0045	.0046	.0048	.0049	0.0050	0.0051
10.....	.00316	.....	.....	.0044	.0045	.0046	.0047	.0049	.0050	.0052	.0053	.0054
8.....	.00354	.....	.....	.....	.....	.0050	.0051	.0053	.0054	.0055	.0057	.0058
6.....	.00408	.....	.....	.....	.....	.....	.....	.0058	.0060	.0061	.0062	.0063
5.....	.00447	.....	.....	.....	.....	.....	.....	.....	.0063	.0065	.0066	.0067
4.....	.00500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.0071	.0072
3.....	.00577	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2½.....	.00632	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2.....	.00707	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1½.....	.00816	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1⅓.....	.00866	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1.....	.01000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Diameter increment, $0.002\sqrt{D}$.....		0.00100	0.00112	0.00122	0.00132	0.00141	0.00158	0.00173	0.00187	0.00200	0.00212	0.00224

Threads per inch, n	Pitch increment, $0.010\sqrt{1/n}$	Pitch diameter tolerances[1] for nominal diameters up to and including—									
		1⅜ in.	1½ in.	1¾ in.	2 in.	2¼ in.	2½ in.	2¾ in.	3 in.	4 in.	5 in.
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
16.....	0.00250	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14.....	.00267	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12.....	.00289	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10.....	.00316	0.0055	0.0056	0.0058	.....	.....	.....	.....	.....	.....	.....
8.....	.00354	.0059	.0060	.0062	0.0064	.....	.....	.....	.....	.....	.....
6.....	.00408	.0064	.0065	.0067	.0069	0.0071	.....	.....	.....	.....	.....
5.....	.00447	.0068	.0069	.0071	.0073	.0075	0.0076	.....	.....	.....	.....
4.....	.00500	.0073	.0074	.0076	.0078	.0080	.0082	0.0083	0.0085	0.0090	.....
3.....	.00577	.....	.....	.0084	.0086	.0088	.0089	.0091	.0092	.0098	0.0102
2½.....	.00632	.....	.....	.0090	.0092	.0093	.0095	.0096	.0098	.0103	.0108
2.....	.00707	.....	.....	.....	.0099	.0101	.0102	.0104	.0105	.0111	.0115
1½.....	.00816	.....	.....	.....	.....	.....	.....	.....	.0116	.0122	.0126
1⅓.....	.00866	.....	.....	.....	.....	.....	.....	.....	.0121	.0127	.0131
1.....	.01000	.....	.....	.....	.....	.....	.....	.....	.....	.0140	.0145
Diameter increment, $0.002\sqrt{D}$.....		0.00235	0.00245	0.00255	0.00283	0.00300	0.00316	0.00332	0.00346	0.00400	0.00447

[1] The equivalent tolerance on thread thickness is 0.259 times the pitch diameter tolerance. For an intermediate nominal diameter, apply the pitch diameter tolerance for the next larger nominal diameter given in this table.

NOTE.—The pitch diameter tolerances shown in these tables equal the sum of the pitch increment in the second column and the diameter increment in the bottom line.

TABLE 98.—*Limiting dimensions and tolerances, Acme general purpose thread series*

Limiting diameters and tolerances	Nominal diameter, D																			
	¼	5/16	⅜	7/16	½	5/8	¾	⅞	1	1⅛	1¼	1⅜	1½	1¾	2	2¼	2½	2¾	3	4	5
	Threads per inch[1]																				
	16	14	12	12	10	8	6	6	5	5	5	4	4	4	4	3	3	3	2	2	2
SCREWS	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Classes 2G, 3G, and 4G, major diameter,[2] D. Max..	0.2500	0.3125	0.3750	0.4375	0.5000	0.6250	0.7500	0.8750	1.0000	1.1250	1.2500	1.3750	1.5000	1.7500	2.0000	2.2500	2.5000	2.7500	3.0000	4.0000	5.0000
Min..	.2469	.3089	.3708	.4333	.4950	.6188	.7417	.8667	0.9900	1.1150	1.2400	1.3625	1.4875	1.7375	1.9875	2.2333	2.4833	2.7333	2.9750	3.9750	4.9750
Tol..	.0031	.0036	.0042	.0042	.0050	.0062	.0083	.0083	.0100	0.0100	0.0100	0.0125	0.0125	0.0125	0.0125	0.0167	0.0167	0.0167	0.0250	0.0250	0.0250
Classes 2G, 3G, and 4G, minor diameter.....Max..	.1775	.2311	.2817	.3442	.3800	.4800	.5633	.6883	.7800	.9050	1.0300	1.1050	1.2300	1.4800	1.7300	1.8967	2.1467	2.3967	2.4800	3.4800	4.4800
Class 2G, minor diam...Min..	.1618	.2140	.2632	.3253	.3594	.4570	.5371	.6615	.7509	.8753	0.9998	1.0719	1.1965	1.4456	1.6948	1.8572	2.1065	2.3558	2.4326	3.4302	4.4281
Class 3G, minor diam...Min..	.1702	.2231	.2731	.3354	.3704	.4693	.5511	.6758	.7664	.8912	1.0159	1.0896	1.2144	1.4640	1.7136	1.8783	2.1279	2.3776	2.4579	3.4568	4.4558
Class 4G, minor diam...Min..	.1722	.2254	.2755	.3379	.3731	.4723	.5546	.6794	.7703	.8951	1.0199	1.0940	1.2188	1.4685	1.7183	1.8835	2.1333	2.3831	2.4642	3.4634	4.4627
Class 2G, pitch diam.. Max..	.2148	.2728	.3284	.3909	.4443	.5562	.6598	.7842	.8920	1.0165	1.1411	1.2406	1.3652	1.6145	1.8637	2.0713	2.3207	2.5700	2.7360	3.7340	4.7319
Min..	.2043	.2614	.3161	.3783	.4306	.5408	.6424	.7663	.8726	0.9967	1.1210	1.2186	1.3429	1.5916	1.8402	2.0450	2.2939	2.5427	2.7044	3.7008	4.6973
Tol..	.0105	.0114	.0123	.0126	.0137	.0154	.0174	.0179	.0194	.0198	0.0201	0.0220	0.0223	0.0229	0.0235	0.0263	0.0268	0.0273	0.0316	0.0332	0.0346
Class 3G, pitch diam.. Max..	.2158	.2738	.3296	.3921	.4458	.5578	.6615	.7861	.8940	1.0186	1.1433	1.2430	1.3677	1.6171	1.8665	2.0743	2.3238	2.5734	2.7395	3.7380	4.7364
Min..	.2109	.2685	.3238	.3862	.4394	.5506	.6534	.7778	.8849	1.0094	1.1339	1.2327	1.3573	1.6064	1.8555	2.0620	2.3113	2.5607	2.7248	3.7225	4.7202
Tol..	.0049	.0053	.0058	.0059	.0064	.0072	.0081	.0083	.0091	0.0092	0.0094	0.0103	0.0104	0.0107	0.0110	0.0123	0.0125	0.0127	0.0147	0.0155	0.0162
Class 4G, pitch diam.. Max..	.2168	.2748	.3309	.3934	.4472	.5593	.6632	.7880	.8960	1.0208	1.1455	1.2453	1.3701	1.6198	1.8693	2.0773	2.3270	2.5767	2.7430	3.7420	4.7409
Min..	.2133	.2710	.3268	.3892	.4426	.5542	.6574	.7820	.8895	1.0142	1.1388	1.2380	1.3627	1.6122	1.8615	2.0685	2.3181	2.5676	2.7325	3.7309	4.7294
Tol..	.0035	.0038	.0041	.0042	.0046	.0051	.0058	.0060	.0065	0.0066	0.0067	0.0073	0.0074	0.0076	0.0078	0.0088	0.0089	0.0091	0.0105	0.0111	0.0115
NUTS																					
Classes 2G, 3G, and 4G, major diameter. Min..	.2600	.3225	.3850	.4475	.5200	.6450	.7700	.8950	1.0200	1.1450	1.2700	1.3950	1.5200	1.7700	2.0200	2.2700	2.5200	2.7700	3.0200	4.0200	5.0200
Max..	.2700	.3325	.3950	.4575	.5400	.6650	.7900	.9150	1.0400	1.1650	1.2900	1.4150	1.5400	1.7900	2.0400	2.2900	2.5400	2.7900	3.0400	4.0400	5.0400
Classes 2G, 3G, and 4G, minor diameter.[2] Min..	.1875	.2411	.2917	.3542	.4000	.5000	.5833	.7083	0.8000	0.9250	1.0500	1.1250	1.2500	1.5000	1.7500	1.9167	2.1667	2.4167	2.5000	3.5000	4.5000
Max..	.1906	.2447	.2959	.3584	.4050	.5062	.5916	.7166	.8100	.9350	1.0600	1.1375	1.2625	1.5125	1.7625	1.9334	2.1834	2.4334	2.5250	3.5250	4.5250
Tol..	.0031	.0036	.0042	.0042	.0050	.0062	.0083	.0083	.0100	.0100	0.0100	0.0125	0.0125	0.0125	0.0125	0.0167	0.0167	0.0167	0.0250	0.0250	0.0250
Class 2G, pitch diam.. Min..	.2188	.2768	.3333	.3958	.4500	.5625	.6667	.7917	.9000	1.0250	1.1500	1.2500	1.3750	1.6250	1.8750	2.0833	2.3333	2.5833	2.7500	3.7500	4.7500
Max..	.2293	.2882	.3456	.4084	.4637	.5779	.6841	.8096	.9194	1.0448	1.1701	1.2720	1.3973	1.6479	1.8985	2.1096	2.3601	2.6106	2.7816	3.7832	4.7846
Tol..	.0105	.0114	.0123	.0126	.0137	.0154	.0174	.0179	.0194	0.0198	0.0201	0.0220	0.0223	0.0229	0.0235	0.0263	0.0268	0.0273	0.0316	0.0332	0.0346
Class 3G, pitch diam.. Min..	.2188	.2768	.3333	.3958	.4500	.5625	.6667	.7917	.9000	1.0250	1.1500	1.2500	1.3750	1.6250	1.8750	2.0833	2.3333	2.5833	2.7500	3.7500	4.7500
Max..	.2237	.2821	.3391	.4017	.4564	.5697	.6748	.8000	.9091	1.0342	1.1594	1.2603	1.3854	1.6357	1.8860	2.0956	2.3458	2.5960	2.7647	3.7655	4.7662
Tol..	.0049	.0053	.0058	.0059	.0064	.0072	.0081	.0083	.0091	0.0092	0.0094	0.0103	0.0104	0.0107	0.0110	0.0123	0.0125	0.0127	0.0147	0.0155	0.0162
Class 4G, pitch diam.. Min..	.2188	.2768	.3333	.3958	.4500	.5625	.6667	.7917	.9000	1.0250	1.1500	1.2500	1.3750	1.6250	1.8750	2.0833	2.3333	2.5833	2.7500	3.7500	4.7500
Max..	.2223	.2806	.3374	.4000	.4546	.5676	.6725	.7977	.9065	1.0316	1.1567	1.2573	1.3824	1.6326	1.8828	2.0921	2.3422	2.5924	2.7605	3.7611	4.7615
Tol..	.0035	.0038	.0041	.0042	.0046	.0051	.0058	.0060	.0065	0.0066	0.0067	0.0073	0.0074	0.0076	0.0078	0.0088	0.0089	0.0091	0.0105	0.0111	0.0115

[1] The selection of threads per inch is arbitrary and is intended for the purpose of establishing a standard.
[2] These dimensions correspond to tolerances on major diameter of screw and minor diameter of nut equal to 0.05p.

TABLE 99.—*Limiting dimensions and tolerances, Acme centralizing thread series, classes 2C, 3C, and 4C*

Limiting diameters and tolerances	Nominal diameter, *D*																
	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1¾	2	2¼	2½	2¾	3	4	5
	Threads per inch																
	10	8	6	6	5	5	5	4	4	4	4	3	3	3	2	2	2
SCREWS																	
Classes 2C, 3C, and 4C, major diameter, *D*.....Max..	*Inch* 0.5000	*Inch* 0.6250	*Inch* 0.7500	*Inch* 0.8750	*Inches* 1.0000	*Inches* 1.1250	*Inches* 1.2500	*Inches* 1.3750	*Inches* 1.5000	*Inches* 1.7500	*Inches* 2.0000	*Inches* 2.2500	*Inches* 2.5000	*Inches* 2.7500	*Inches* 3.0000	*Inches* 4.0000	*Inches* 5.0000
Class 2C, major diameter.....Min..	0.4975	0.6222	0.7470	0.8717	0.9965	1.1213	1.2461	1.3709	1.4957	1.7454	1.9951	2.2448	2.4945	2.7442	2.9939	3.9930	4.9922
Tol..	.0025	.0028	.0030	.0033	.0035	0.0037	0.0039	0.0041	0.0043	0.0046	0.0049	0.0052	0.0055	0.0058	0.0061	0.0070	0.0078
Class 3C, major diameter.....Min..	.4989	.6238	.7487	.8736	.9985	1.1234	1.2483	1.3732	1.4982	1.7480	1.9979	2.2478	2.4976	2.7475	2.9974	3.9970	4.9966
Tol..	.0011	.0012	.0013	.0014	.0015	0.0016	0.0017	0.0018	0.0018	0.0020	0.0021	0.0022	0.0024	0.0025	0.0026	0.0030	0.0034
Class 4C, major diameter.....Min..	.4993	.6242	.7491	.8741	.9990	1.1239	1.2489	1.3738	1.4988	1.7487	1.9986	2.2485	2.4984	2.7483	2.9983	3.9980	4.9978
Tol..	.0007	.0008	.0009	.0009	.0010	0.0011	0.0011	0.0012	0.0012	0.0013	0.0014	0.0015	0.0016	0.0017	0.0017	0.0020	0.0022
Classes 2C, 3C, and 4C, minor diameter.....Max..	.3800	.4800	.5633	.6883	.7800	.9050	1.0300	1.1050	1.2300	1.4800	1.7300	1.8967	2.1467	2.3967	2.4800	3.4800	4.4800
Class 2C, minor diameter.....Min..	.3594	.4570	.5371	.6615	.7509	.8753	0.9998	1.0719	1.1965	1.4456	1.6948	1.8572	2.1065	2.3558	2.4326	3.4302	4.4281
Class 3C, minor diameter.....Min..	.3704	.4693	.5511	.6758	.7664	.8912	1.0159	1.0896	1.2144	1.4640	1.7136	1.8783	2.1279	2.3776	2.4579	3.4568	4.4558
Class 4C, minor diameter.....Min..	.3731	.4723	.5546	.6794	.7703	.8951	1.0199	1.0940	1.2188	1.4685	1.7183	1.8835	2.1333	2.3831	2.4642	3.4634	4.4627
Class 2C, pitch diameter.....Max..	.4443	.5562	.6598	.7842	.8920	1.0165	1.1411	1.2406	1.3652	1.6145	1.8637	2.0713	2.3207	2.5700	2.7360	3.7340	4.7319
Min..	.4306	.5408	.6424	.7663	.8726	0.9967	1.1210	1.2186	1.3429	1.5916	1.8402	2.0450	2.2939	2.5427	2.7044	3.7008	4.6973
Tol..	.0137	.0154	.0174	.0179	.0194	.0198	0.0201	0.0220	0.0223	0.0229	0.0235	0.0263	0.0268	0.0273	0.0316	0.0332	0.0346
Class 3C, pitch diameter.....Max..	.4458	.5578	.6615	.7861	.8940	1.0186	1.1433	1.2430	1.3677	1.6171	1.8665	2.0743	2.3238	2.5734	2.7395	3.7380	4.7364
Min..	.4394	.5506	.6534	.7778	.8849	1.0094	1.1339	1.2327	1.3573	1.6064	1.8555	2.0620	2.3113	2.5607	2.7248	3.7225	4.7202
Tol..	.0064	.0072	.0081	.0083	.0091	0.0092	0.0094	0.0103	0.0104	0.0107	0.0110	0.0123	0.0125	0.0127	0.0147	0.0155	0.0162
Class 4C, pitch diameter.....Max..	.4472	.5593	.6632	.7880	.8960	1.0208	1.1455	1.2453	1.3701	1.6198	1.8693	2.0773	2.3270	2.5767	2.7430	3.7420	4.7409
Min..	.4426	.5542	.6574	.7820	.8895	1.0142	1.1388	1.2380	1.3627	1.6122	1.8615	2.0685	2.3181	2.5676	2.7325	3.7309	4.7294
Tol..	.0046	.0051	.0058	.0060	.0065	0.0066	0.0067	0.0073	0.0074	0.0076	0.0078	0.0088	0.0089	0.0091	0.0105	0.0111	0.0115
NUTS																	
Classes 2C, 3C, and 4C, major diameter.....Min..	.5007	.6258	.7509	.8759	1.0010	1.1261	1.2511	1.3762	1.5012	1.7513	2.0014	2.2515	2.5016	2.7517	3.0017	4.0020	5.0022
Classes 2C, and 3C, major diam Max..	.5032	.6286	.7539	.8792	1.0045	1.1298	1.2550	1.3803	1.5055	1.7559	2.0063	2.2567	2.5071	2.7575	3.0078	4.0090	5.0100
Tol..	.0025	.0028	.0030	.0033	0.0035	0.0037	0.0039	0.0041	0.0043	0.0046	0.0049	0.0052	0.0055	0.0058	0.0061	0.0070	0.0078
Class 4C, major diameter.....Max..	.5021	.6274	.7526	.8778	1.0030	1.1282	1.2533	1.3785	1.5036	1.7539	2.0042	2.2545	2.5048	2.7550	3.0052	4.0060	5.0067
Tol..	.0014	.0016	.0017	.0019	0.0020	0.0021	0.0022	0.0023	0.0024	0.0026	0.0028	0.0030	0.0032	0.0033	0.0035	0.0040	0.0045
Classes 2C, 3C, and 4C, minor diameter. Min..	.4100	.5125	.6000	.7250	.8200	.9450	1.0700	1.1500	1.2750	1.5250	1.7750	1.9500	2.2000	2.4500	2.5500	3.5500	4.5500
Max..	.4150	.5187	.6083	.7333	.8300	.9550	1.0800	1.1625	1.2875	1.5375	1.7875	1.9667	2.2167	2.4667	2.5750	3.5750	4.5750
Tol..	.0050	.0062	.0083	.0083	.0100	.0100	0.0100	0.0125	0.0125	0.0125	0.0125	0.0167	0.0167	0.0167	0.0250	0.0250	0.0250
Class 2C, pitch diameter.....Min..	.4500	.5625	.6667	.7917	.9000	1.0250	1.1500	1.2500	1.3750	1.6250	1.8750	2.0833	2.3333	2.5833	2.7500	3.7500	4.7500
Max..	.4637	.5779	.6841	.8096	.9194	1.0448	1.1701	1.2720	1.3973	1.6479	1.8985	2.1096	2.3601	2.6106	2.7816	3.7832	4.7846
Tol..	.0137	.0154	.0174	.0179	.0194	0.0198	0.0201	0.0220	0.0223	0.0229	0.0235	0.0263	0.0268	0.0273	0.0316	0.0332	0.0346
Class 3C, pitch diameter.....Min..	.4500	.5625	.6667	.7917	.9000	1.0250	1.1500	1.2500	1.3750	1.6250	1.8750	2.0833	2.3333	2.5833	2.7500	3.7500	4.7500
Max..	.4564	.5697	.6748	.8000	.9091	1.0342	1.1594	1.2603	1.3854	1.6357	1.8860	2.0956	2.3458	2.5960	2.7647	3.7655	4.7662
Tol..	.0064	.0072	.0081	.0083	.0091	0.0092	0.0094	0.0103	0.0104	0.0107	0.0110	0.0123	0.0125	0.0127	0.0147	0.0155	0.0162
Class 4C, pitch diameter.....Min..	.4500	.5625	.6667	.7917	.9000	1.0250	1.1500	1.2500	1.3750	1.6250	1.8750	2.0833	2.3333	2.5833	2.7500	3.7500	4.7500
Max..	.4546	.5676	.6725	.7977	.9065	1.0316	1.1567	1.2573	1.3824	1.6326	1.8828	2.0921	2.3422	2.5924	2.7605	3.7611	4.7615
Tol..	.0046	.0051	.0058	.0060	.0065	0.0066	0.0067	0.0073	0.0074	0.0076	0.0078	0.0088	0.0089	0.0091	0.0105	0.0111	0.0115

TABLE 99(A).—*Limiting dimensions and tolerances, Acme centralizing thread series, classes 5C and 6C*

Limiting diameters and tolerances	Nominal diameter, *D*																
	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1¾	2	2¼	2½	2¾	3	4	5
	Threads per inch																
	10	8	6	6	5	5	5	4	4	4	4	3	3	3	2	2	2
SCREWS																	
Classes 5C and 6C, major diameter, *B*.....Max..	*Inch* 0.4823	*Inch* 0.6052	*Inch* 0.7283	*Inch* 0.8516	*Inch* 0.9750	*Inches* 1.0985	*Inches* 1.2220	*Inches* 1.3457	*Inches* 1.4694	*Inches* 1.7169	*Inches* 1.9646	*Inches* 2.2125	*Inches* 2.4605	*Inches* 2.7085	*Inches* 2.9567	*Inches* 3.9500	*Inches* 4.9441
Class 5C, major diameter.....Min..	.4812	.6040	.7270	.8502	.9735	1.0969	1.2203	1.3439	1.4676	1.7149	1.9625	2.2103	2.4581	2.7060	2.9541	3.9470	4.9407
Tol..	.0011	.0012	.0013	.0014	.0015	.0016	.0017	.0018	.0018	.0020	.0021	.0022	.0024	.0025	.0026	.0030	.0034
Class 6C, major diameter.....Min..	.4816	.6044	.7274	.8507	.9740	1.0974	1.2209	1.3445	1.4682	1.7156	1.9632	2.2110	2.4589	2.7068	2.9550	3.9480	4.9419
Tol..	.0007	.0008	.0009	.0009	.0010	0.0011	0.0011	0.0012	0.0012	0.0013	0.0014	0.0015	0.0016	0.0017	0.0017	0.0020	0.0022
Classes 5C and 6C, minor diameter.....Max..	.3623	.4602	.5416	.6649	.7550	.8785	1.0020	1.0757	1.1994	1.4469	1.6946	1.8592	2.1072	2.3552	2.4367	3.4300	4.4241
Class 5C, minor diameter.....Min..	.3527	.4495	.5294	.6524	.7414	.8647	.9879	1.0603	1.1838	1.4308	1.6782	1.8408	2.0884	2.3361	2.4146	3.4068	4.3999
Class 6C, minor diameter.....Min..	.3554	.4525	.5329	.6560	.7453	.8686	.9919	1.0647	1.1882	1.4354	1.6829	1.8460	2.0938	2.3416	2.4209	3.4134	4.4068
Class 5C, pitch diameter.....Max..	.4266	.5364	.6381	.7608	.8670	.9900	1.1131	1.2113	1.3346	1.5814	1.8283	2.0338	2.2812	2.5285	2.6927	3.6840	4.6760
Min..	.4202	.5292	.6300	.7525	.8579	.9808	1.1037	1.2010	1.3242	1.5707	1.8173	2.0215	2.2687	2.5158	2.6780	3.6685	4.6598
Tol..	.0064	.0072	.0081	.0083	.0091	.0092	0.0094	0.0103	0.0104	0.0107	0.0110	0.0123	0.0125	0.0127	0.0147	0.0155	0.0162
Class 6C, pitch diameter.....Max..	.4281	.5380	.6398	.7627	.8690	.9921	1.1153	1.2137	1.3371	1.5840	1.8311	2.0368	2.2843	2.5319	2.6962	3.6880	4.6805
Min..	.4235	.5329	.6340	.7567	.8625	.9855	1.1086	1.2064	1.3297	1.5764	1.8233	2.0280	2.2754	2.5228	2.6857	3.6769	4.6690
Tol..	.0046	.0051	.0058	.0060	.0065	.0066	0.0067	0.0073	0.0074	0.0076	0.0078	0.0088	0.0089	0.0091	0.0105	0.0111	0.0115
NUTS																	
Classes 5C and 6C, major diameter.....Min..	.4830	.6060	.7292	.8525	.9760	1.0996	1.2231	1.3469	1.4706	1.7182	1.9660	2.2140	2.4621	2.7102	2.9584	3.9520	4.4963
Class 5C, major diameter.....Max..	.4855	.6088	.7322	.8558	.9795	1.1033	1.2270	1.3510	1.4749	1.7228	1.9709	2.2192	2.4676	2.7160	2.9645	3.9590	4.5041
Tol..	.0025	.0028	.0030	.0033	.0035	0.0037	0.0039	0.0041	0.0043	0.0046	0.0049	0.0052	0.0055	0.0058	0.0061	0.0070	0.0078
Class 6C, major diameter.....Max..	.4844	.6076	.7309	.8544	.9780	1.1017	1.2253	1.3492	1.4730	1.7208	1.9688	2.2170	2.4653	2.7135	2.9619	3.9560	4.5008
Tol..	.0014	.0016	.0017	.0019	.0020	0.0021	0.0022	0.0023	0.0024	0.0026	0.0028	0.0030	0.0032	0.0033	0.0035	0.0040	0.0045
Classes 5C and 6C, minor diameter. Min..	.3923	.4927	.5783	.7016	.7950	.9185	1.0420	1.1207	1.2444	1.4919	1.7396	1.9125	2.1605	2.4085	2.5067	3.5000	4.4941
Max..	.3973	.4989	.5866	.7099	.8050	.9285	1.0520	1.1332	1.2569	1.5044	1.7521	1.9292	2.1772	2.4252	2.5317	3.5250	4.5191
Tol..	.0050	.0062	.0083	.0083	.0100	.0100	0.0100	0.0125	0.0125	0.0125	0.0125	0.0167	0.0167	0.0167	0.0250	0.0250	0.0250
Class 5C, pitch diameter.....Min..	.4323	.5427	.6450	.7683	.8750	.9985	1.1220	1.2207	1.3444	1.5919	1.8396	2.0458	2.2938	2.5418	2.7067	3.7000	4.6941
Max..	.4387	.5499	.6531	.7766	.8841	1.0077	1.1314	1.2310	1.3548	1.6026	1.8506	2.0581	2.3063	2.5545	2.7214	3.7155	4.7103
Tol..	.0064	.0072	.0081	.0083	.0091	0.0092	0.0094	0.0103	0.0104	0.0107	0.0110	0.0123	0.0125	0.0127	0.0147	0.0155	0.0162
Class 6C, pitch diameter.....Min..	.4323	.5427	.6450	.7683	.8750	.9985	1.1220	1.2207	1.3444	1.5919	1.8396	2.0458	2.2938	2.5418	2.7067	3.7000	4.6941
Max..	.4369	.5478	.6508	.7743	.8815	1.0051	1.1287	1.2280	1.3518	1.5995	1.8474	2.0546	2.3027	2.5509	2.7172	3.7111	4.7056
Tol..	.0046	.0051	.0058	.0060	.0065	0.0066	0.0067	0.0073	0.0074	0.0076	0.0078	0.0088	0.0089	0.0091	0.0105	0.0111	0.0115

7. GAGES FOR ACME THREADS

Both "go" and "not go" gages, representing the extreme product limits, or adequate gaging instruments for thread elements, are necessary for the proper inspection of Acme screw threads. The dimensions of "go" and "not go" gages should be in accordance with the principles: (a) that the "go" gage should check simultaneously as many elements as possible and a "not go" gage can effectively check but one element; and (b) that permissible variations in the gages be kept within the extreme product limits.

(a) GAGE TOLERANCES

Tolerances for the thread elements of "go" and "not go" thread gages for Acme threads are given in tables 12, p. 39, and 100, p. 179.

1. TOLERANCES ON PITCH DIAMETER.—The pitch diameter tolerances for gages for class 2 screws and nuts are given in table 100, column 2, and for gages for classes 3, 4, 5, and 6 screws and nuts in table 100, column 3.

2. TOLERANCES ON MAJOR AND MINOR DIAMETERS.—The major and minor diameter tolerances for Acme thread gages are given in table 100, column 4. These are applicable to all gages except the "go" thread plug gages for all classes of centralizing nuts, "not go" thread plug gages for major diameter of all classes of centralizing nuts, and for "go" and "not go" plain ring or snap gages for major diameter of centralizing screws. For these gages the tolerances are class Z, as given in table 12, p. 39.

3. TOLERANCES ON LEAD.—The variation in lead of all Acme thread gages for classes 3, 4, 5, and 6 product shall not exceed 0.0002 inch between any two threads not farther apart than one inch. However, the cumulative error in lead shall not exceed 0.0003 inch for gages above 1 to 3 inches long; or 0.0004 inch for gages above 3 to 5 inches long; or 0.0006 inch for gages above 5 to 10 inches long. For gages for class 2 product, 0.0001 inch shall be added to the above values. For multiple threads, the cumulative tolerance for pitch and lead shall be multiplied by 1.5.

4. TOLERANCES ON ANGLE OF THREAD.—The tolerances on angle of thread, as specified in table 100, column 5, for the various pitches, are tolerances on one-half of the included angle. This insures that the bisector of the included angle will be perpendicular to the axis of the thread within proper limits. The equivalent deviation from the true thread form caused by such irregularities as convex or concave sides of thread, or slight projections on the thread form, should not exceed the tolerances permitted on angle of thread.

(b) GAGES FOR SCREW

1. "GO" THREAD RING OR THREAD SNAP GAGE.—(*a*) *Major diameter.*—The major diameter of the "go" thread ring or thread snap gage shall clear a diameter greater by 0.01 inch than the maximum major diameter of the screw.

(*b*) *Pitch diameter.*—The pitch diameter shall fit the "go" thread setting plug gage.

(*c*) *Minor diameter.*—For general purpose screws, the minor diameter shall be the same as the maximum minor diameter of the screw plus 0.005 inch for pitches finer than 10 threads per inch, and plus 0.010 inch for 10 threads per inch and coarser, to allow for possible errors in concentricity of the pitch and minor diameters of the product. For centralizing screws the minor diameter of the "go" thread ring gage shall be smaller than the minimum minor diameter of the nut by the amount of the allowance on pitch diameter, table 94, columns 3 to 5. The tolerance (table 100, column 4) shall be minus.

(*d*) *Length.*—The length of the "go" ring gage shall be the length of engagement, but shall not exceed the length specified in table 101, column 3.

2. "GO" THREAD SETTING PLUG FOR "GO" THREAD RING OR SNAP GAGES.—(*a*) *Major diameter.*—The major diameter of the full-form "go" thread setting plug gage shall be the same as the maximum major diameter of the screw. The gage tolerance (table 100, column 4) shall be taken plus. The major diameter of the truncated "go" thread setting plug

gage shall be smaller by one-third basic thread depth ($=p/6$) than the maximum major diameter of the screw. The gage tolerance (table 100, column 4) shall be taken minus.

(*b*) *Pitch diameter.*—For all general purpose screws, the pitch diameter shall be the same as the maximum pitch diameter of the screw. For centralizing screws, if the product length of engagement exceeds the length of the ring gage, table 101, column 3, the pitch diameter shall be less than the maximum pitch diameter of the screw by the amount stated in table 101, column 5. The gage tolerance (table 100, columns 2 and 3) shall be minus.

(*c*) *Minor diameter.*—The minor diameter shall be cleared below the minimum minor diameter of the "go" thread ring gage.

(*d*) *Length.*—The length of all "go" setting plug gages shall equal the length of the "go" thread ring or snap gage.

3. "Go" Plain Ring or Snap Gage for Major Diameter.—The diameter of the "go" plain ring gage, or gaging dimension of the "go" plain snap gage, shall be the same as the maximum major diameter of the screw. The class Z tolerances given in table 12, p. 39, shall be applicable to gages for centralizing threads. Tolerances given in table 100, column 4, shall be applicable to gages for general purpose threads. Tolerances shall be taken in the minus direction.

4. "Not Go" Thread Ring or Thread Snap Gage.—(*a*) *Major diameter.*—The major diameter of the "not go" thread ring or thread snap gage shall clear a diameter greater by 0.01 inch than the maximum major diameter of the screw. Clearance cut may have $0.435p$ maximum width at intersection with flanks of thread.

(*b*) *Pitch diameter.*—The pitch diameter shall fit the "not go" thread setting plug gage.

(*c*) *Minor diameter.*—The minor diameter shall be the basic minor diameter of the nut plus $p/4$, with the tolerance (table 100, column 4) taken plus.

(*d*) *Length.*—The length shall be a minimum of three pitches and a maximum of four.

5. Thread Setting Plug for "Not Go" Thread Ring or Thread Snap Gage.—(*a*) *Major diameter.*—The major diameter of the full-form "not go" thread setting plug gage shall be the same as the maximum major diameter of the screw. The gage tolerance (table 100, column 4) shall be taken plus. The major diameter of the truncated "not go" thread setting plug gage shall be truncated one-third basic thread depth ($=p/6$) smaller than the maximum major diameter of the screw. The gage tolerance (table 100, column 4) shall be taken minus.

(*b*) *Pitch diameter.*—The pitch diameter shall be the same as the minimum pitch diameter of the screw, with the tolerance taken plus.

(*c*) *Minor diameter.*—The minor diameter shall be cleared below the minimum minor diameter of the "not go" thread ring gage.

(*d*) *Length.*—The length shall exceed the length of the "not go" thread ring or snap gage by at least one pitch.

6. "Not Go" Plain Snap Gage for Major Diameter.—The gaging dimension of the "not go" plain snap gage shall be the same as the minimum major diameter of the screw. The class Z tolerances given in table 12, p. 39, shall be applicable for centralizing threads. Tolerances in table 101, column 4 shall apply to gages for general purpose threads. Gage tolerances shall be taken in the plus direction.

(c) Gages for Nut

1. "Go" Thread Plug Gage, General Purpose.—(*a*) *Major diameter.*—The major diameter of the "go" thread plug gage for general purpose threads shall be equal to the minimum major diameter of the nut minus 0.005 inch for pitches finer than 10 threads per inch, and minus 0.010 inch for 10 threads per inch and coarser, to allow for possible errors in concentricity of the pitch and major diameters of the product. The gage tolerance (table 100, column 4) shall be plus.

(*b*) *Pitch diameter.*—The pitch diameter shall be equal to the minimum (basic) pitch diameter of the nut, with the tolerance (table 100, columns 2 and 3) taken plus.

(*c*) *Minor diameter.*—The minor diameter shall clear a diameter less by 0.01 inch than the minimum minor diameter of the nut.

(*d*) *Length.*—The length shall be the length of engagement, but shall not exceed

twice the nominal major diameter, unless otherwise specified.

2. "Go" Thread Plug Gage for Centralizing Threads.—(a) *Major diameter.*—The major diameter shall be the same as the minimum major diameter of the nut with a plus tolerance, class Z (table 12, p. 39). Both corners at the crest shall be chamfered equally at an angle of 45°, leaving a width of flat at crest of $0.28p + 0.00, - 0.02p$.

(b) *Pitch diameter and minor diameter, and length.*—The pitch diameter, minor diameter, and length of gage shall be the same as 1(b), 1(c), and 1(d) above.

3. "Not Go" Thread Plug Gage for Pitch Diameter of All Nuts.—(a) *Major diameter.*—The major diameter of the "not go" thread plug gage shall be equal to the maximum (basic) major diameter of the screw minus $p/4$, with the tolerance (table 100, column 4) taken minus.

(b) *Pitch diameter.*—The pitch diameter shall be the same as the maximum pitch diameter of the nut, with the tolerance (table 100, columns 2 and 3) taken minus.

(c) *Minor diameter.*—The minor diameter shall clear a diameter less by 0.01 inch than the minimum minor diameter of the nut. Clearance cut may have $0.435p$ maximum width at intersection with flanks of thread.

(d) *Length.*—The length shall be a minimum of three pitches and a maximum of four, except that in the case of multiple threads the length shall provide one full turn of thread.

4. "Not Go" Thread Plug for Major Diameter of Centralizing Nut.—The major diameter shall be equal to the maximum major diameter of the nut. The tolerance shall be class Z (table 12, p. 39), taken minus. The included angle of the thread shall be 29°. The pitch diameter shall be the maximum pitch diameter of the class 4 centralizing *screw* (for centralizing nuts, classes 2, 3 and 4) or the maximum pitch diameter of the class 6 centralizing *screw* (for centralizing nuts, classes 5 and 6), with a minus tolerance of twice that given in table 100, column 3. The crest corners shall be chamfered 45° equally to leave a central flat not more than $0.24p$ wide. The approximate depth of chamfer is $0.7p$. The minor diameter shall clear a diameter less by 0.01 inch than the minimum minor diameter of the nut. The length shall be a minimum of three pitches and a maximum of four, except that in the case of multiple threads the length shall provide one full turn of thread.

5. "Go" Plain Plug Gage for Minor Diameter of Nut.—The diameter of the "go" plain plug gage shall be the same as the minimum minor diameter of the nut. The gage tolerance shall be class Z (table 12, p. 39), taken plus. The length shall be in accordance with Commercial Standard CS8-41, Gage Blanks.

6. "Not Go" Plain Plug for Minor Diameter of Nut.—The diameter of the "not go" plain plug gage shall be the same as the maximum minor diameter of the nut. The gage tolerance shall be class Z (table 12, p. 39), taken minus. The length shall be in accordance with CS8-41.

Table 100.—*Tolerances for "go" and "not go" thread gages, Acme threads*

Threads per inch	Tolerance on pitch diameter[1]		Tolerance on major and minor diameters[2]	Tolerance on half angle of thread	
	Class 2	Classes 3 to 6			
1	2	3	4	5	
	Inch	*Inch*	*Inch*	*Deg.*	*Min.*
				±	
16	0.0006	0.0005	0.001	0	10
14	.0006	.0005	.001	0	10
12	.0006	.0006	.001	0	10
10	.0007	.0006	.002	0	10
8	.0008	.0007	.002	0	8
6	.0009	.0007	.002	0	8
5	.0010	.0008	.002	0	8
4	.0011	.0008	.002	0	8
3	.0013	.0008	.002	0	6
2½	.0014	.0009	.002	0	6
2	.0015	.0010	.002	0	6
1½	.0018	.0010	.002	0	5
1⅓	.0018	.0010	.002	0	5
1	.0021	.0010	.002	0	5

[1] These pitch diameter tolerances for thread *gages* are not cumulative; that is, they do not include tolerances on lead and on half angle. Lead tolerances are given on p. 177.

[2] Not applicable to certain gages for centralizing nuts. See par. 7 (a) 2, p. 177.

(d) CONCENTRICITY

Methods of securing concentricity between major and pitch diameters of screw or nut must be determined for each individual application.

TABLE 101.—*Pitch diameter compensation for adjusted lengths of "go" ring gages for centralizing fits*

Nominal major diameter of screw		Length of "go" ring gage	Maximum amount 2 diameters length of engagement exceeds length of gage	Maximum Amount pitch diameter of "go" ring shall be less than maximum pitch diameter of screw
Above—	To and including—			
1	2	3	4	5
Inches	*Inches*		*Inches*	*Inch*
0	1	2 diameters	.....	.....
1	1⅛	2 inches	¼	0.0012
1⅛	1¼	2 inches	½	.0012
1¼	1⅜	2 inches	¾	.0015
1⅜	1½	2 inches	1	.0015
1½	1¾	2 inches	1½	.0015
1¾	2	2 inches	2	.0019
2	2¼	2½ inches	2	.0019
2¼	2½	2½ inches	2½	.0019
2½	2¾	2½ inches	3	.0019
2¾	3	3 inches	3	.0019
3	4	3 inches	5	.0027
4	5	3 inches	7	.0039

NOTE.—The above compensation is based on a length of engagement of two diameters and on a lead error in the product not exceeding the following values (in inch):

0.0003 in length of ½ inch or less.
.0004 in length over ½ to 1½ inches.
.0005 in length over 1½ to 3 inches.
.0007 in length over 3 to 6 inches.
.0010 in length over 6 to 10 inches.

When the length of engagement exceeds the value given in column 3, the cumulative lead error shall be determined.

SECTION XI. WRENCH-HEAD BOLTS AND NUTS, AND WRENCH OPENINGS[26]

These standards for wrench-head bolts and nuts and wrench openings are intended for general use and to replace such other series of dimensions as have been used.

In all cases the basic widths across flats of bolt heads and nuts are taken as maximum sizes and the tolerances on bolt heads and nuts are minus only. The minimum wrench openings are made to provide a positive clearance between maximum nut and minimum wrench, and the tolerances on wrench openings are plus only. This insures assembly of the wrench on the bolt head or nut, whereas the tolerances are as large as possible without causing the deformation of the corners of bolt heads or nuts by the wrenches.

Terms relating to bolt heads and nuts are defined in section II, p. 3.

1. SERIES OF BOLT HEADS AND NUTS

(*a*) REGULAR SERIES BOLT HEADS AND NUTS.—Regular bolt heads and nuts are for general use. The dimensions and the resulting strengths of these bolt heads and nuts are based on theoretical analysis of stresses and on results of numerous tests.

(*b*) HEAVY SERIES BOLT HEADS AND NUTS.—Heavy bolt heads and nuts are for use where greater bearing surface is necessary, that is, where a large clearance between the bolt and hole or a greater wrench bearing surface is considered essential.

(*c*) LIGHT SERIES NUTS.—Light nuts have smaller widths across flats than regular series nuts.

2. RECOMMENDED REQUIREMENTS, BOLTS AND CAP SCREWS

(*a*) WORKMANSHIP.—The workmanship shall be compatible with the type of product and class of fit and finish specified. The product shall be free from abnormal scale, fins, seams, or other defects. All bolts and screws shall be free from any defects which might affect their serviceability.

(*b*) THREAD SERIES.—Unless otherwise specified the number of threads per inch shall be that specified for the American National coarse-thread series or the American National fine-thread series.[27]

(*c*) DETAILS OF DESIGN.—1. *Length of bolts.*—Bolt length is measured from the greatest diameter of the under surface of the head to the end of the bolt. The length of bolts shall not vary from the specified length by more than the following table given on p. 65 of the 1941 book of Standards of the American Institute of Bolt, Nut, and Rivet Manufacturers:

Length of bolt, *L*	Tolerance on length for sizes			
	¼ to ⅜ in., inclusive	7/16 to ½ in., inclusive	⅝ to 1¼ in., inclusive	1⅜ to 3 in., inclusive
	Inch ±	*Inch* ±	*Inch* ±	*Inch* ±
6 inches and under..	1/32	1/16	⅛	¼
Over 6 inches.....	1/16	3/32	3/16	¼

2. *Length of threads.*—The minimum length of thread of all types of bolts, except cap screws, shall, unless otherwise specified, conform to table 102. The minimum thread length is measured from the end of the bolt to the last complete thread. The length of incomplete thread shall not exceed 2½ threads.

For bolts too short for the specified minimum thread lengths, threads shall be cut or rolled to within ¼ in. of head or neck on sizes up to and including ½ in.; ⅜ in. on sizes 9/16 to 1 in., inclusive; ½ in. on sizes 1⅛ to 2 in., inclusive; and ¾ in. on sizes 2⅛ to 3 in., inclusive.

3. *Tolerances on body diameter.*—Tolerances on body diameter of screws and bolts are not included in this handbook. The practice followed should be consistent with the type and class of product specified.

[26] This standard is in agreement with that adopted by the American Standards Association and published as ASA B18.2-1941 "Wrench head bolts and nuts, and wrench openings" by the ASME, 29 West 39th St., New York 18, N. Y. (15c)

[27] The 1⅝- and 1⅞-in. sizes are not in these thread series, but are commonly threaded to the 8-pitch thread series.

Body diameters are, of course, primarily controlled by stock sizes and process of manufacture. Close tolerances on body diameters will, therefore, require close control of stock sizes. Producers of screws and bolts should keep this fact in mind when ordering or inspecting screw and bolt stock. Purchasers of screws and bolts should also keep this in mind and should not insist on body diameter tolerances that are closer than necessary for the purpose.

4. *Taper of heads.*—The taper of the sides of bolt heads (the angle between one side and the axis) shall not exceed 2°. The largest width shall not exceed the specified maximum width across flats.

5. *Top of heads.*—The tops of heads of square and hexagonal bolts shall be flat and chamfered. The angle of chamfer with the top surface shall be 30° for hexagonal bolts and 25° for square bolts. The diameter of the top flat circle shall be the maximum width across flats, within a tolerance of minus 15 percent.

6. *Fillet under heads.*—The maximum radius under the head of bolts, except cap screws, for sizes ¼, to ½ in. shall be 1/32 in.; for sizes 9/16 to 1 in. shall be 1/16 in.; for sizes 1⅛ to 2 in. shall be ⅛ in.; and for sizes 2¼ to 3 in. shall be 3/16 in.

7. *Bearing Surface.*—(*a*) *Unfinished bolt heads.*—The bearing surface of unfinished bolt heads shall be at right angles to the axis of the body of the bolt within a tolerance of 3° for 1-in. bolts or smaller, and 2° for bolts larger than 1 in.; and shall be concentric with the axis of the body within a tolerance of 3 percent of the maximum width across flats.

(*b*) *Semifinished bolt heads.*—The bearing surface of semifinished bolt heads shall be washer faced. The thickness of the washer face shall be approximately 1/64 in. included in the height of head, and the diameter of the washer face shall be the maximum width across flats within a tolerance of minus 5 percent.

The bearing surface shall be at right angles to the axis of the body of the bolt within a tolerance of 2° for 1-in. bolts or smaller, and 1° for bolts larger than 1 in.; and shall be concentric with the axis of the body within a tolerance of 3 percent of the maximum width across flats.

3. TABLES OF DIMENSIONS, BOLTS AND CAP SCREWS

(*a*) Regular Bolt Heads.—1. *Unfinished square and hexagon.*—Head dimensions of unfinished square and hexagon regular bolts shall conform to table 103.

2. *Semifinished hexagon.*—Head dimensions of semifinished hexagon regular bolts shall conform to table 104.

3. *Finished hexagon.*—Finished regular bolt heads, when specified, shall be made to the dimensions and tolerances given for the semifinished product, the degree and character of finish to be specified in each case.

(*b*) Heavy Bolt Heads.—1. *Unfinished square and hexagon.*—Head dimensions of unfinished square and hexagon heavy bolts shall conform to table 105.

2. *Semifinished hexagon.*—Head dimensions of semifinished hexagon heavy bolts shall conform to table 106.

3. *Finished hexagon.*—Finished heavy bolt heads, when specified, shall be made to the dimensions and tolerances given for the semifinished product; the degree and character of finish to be specified in each case.

(*c*) Cap Screw Heads, Hexagon.—Full finished hexagon head cap screws have all surfaces, including body and all surfaces of the head, machined or otherwise treated to provide a surface which is equivalent in appearance. For special applications the quality of full finish may be agreed upon by the user and the manufacturer.

1. *Head dimensions.*—Head dimensions of hexagon cap screws shall conform to table 107, and these apply both to full-finished hexagon head cap screws and to automotive hexagon head bolts.

2. *Length of threads.*—The length of thread in either the coarse- or fine-thread series shall be equal to twice the diameter plus ¼ in. The minimum thread length is measured from the extreme end of the bolt to the last complete thread. Product too short to permit the formula length of thread shall be threaded as close to the head as practicable.

3. *Fillet under head.*— The radius of fillet under head for sizes ¼ to ⅝ in. shall be 0.01 to 1/64 in.; for sizes 11/16 to 1 in. shall be 1/64 to 1/32 in.; for sizes 1 1/16 to 1¼ in. shall be 1/32 to 3/64 in.

4. *Bearing surface.*—The bearing surface shall be washer faced unless otherwise specified. The thickness of the washer face shall be approximately 1/64 in. included in the height of head, and the diameter of the washer face shall be the maximum width across flats within a tolerance of minus 5 percent.

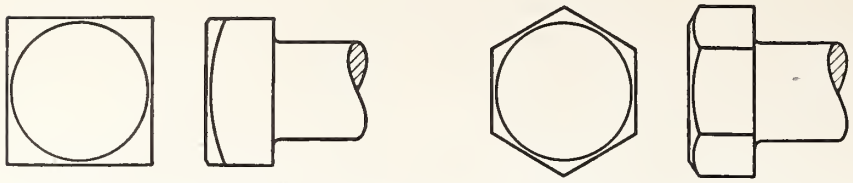
The bearing surface shall be at right angles to the axis of the body within a tolerance of 2° for 1 in. or smaller, and 1° for diameters larger than 1 in.; and shall be concentric with the axis of the body within a tolerance of 3 percent of the maximum width across flats.

TABLE 102.—*Minimum length of threaded portion of bolts*

Length of bolt[1]	Diameter of bolt, inches														
	No. 10, ¼	5/16, 3/8	7/16, ½	9/16, 5/8	¾	⅞	1	1⅛, 1¼	1⅜, 1½	1⅝, 1¾	1⅞, 2	2¼	2½	2¾	3
	Minimum thread length														
Inches	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
¾	½	½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1	¾	¾	¾	¾	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1¼	¾	¾	1	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1½	¾	⅞	1	1⅛	1⅛	1⅛	.....	.....	.....	.....	.....	.....	.....	.....	.....
1¾	¾	⅞	1	1 5/16	1⅜	1⅜	1⅜	.....	.....	.....	.....	.....	.....	.....	.....
2	¾	1	1¼	1¼	1⅜	1 9/16	1⅝	1⅝	.....	.....	.....	.....	.....	.....	.....
2½	¾	1	1¼	1½	1½	1 9/16	1¾	2	2	.....	.....	.....	.....	.....	.....
3	⅞	1	1¼	1½	1¾	1¾	1¾	2⅛	2½	2½	.....	.....	.....	.....	.....
4	⅞	1	1¼	1½	1¾	2	2¼	2¼	2½	2⅞	3¼	3¼	3¼	.....	.....
5	⅞	1 3/16	1¼	1½	1¾	2	2¼	2¾	2¾	2⅞	3¼	3⅝	4	4⅛	4¼
6	⅞	1 3/16	1½	1½	1¾	2	2¼	2¾	3¼	3¼	3¼	3⅝	4	4⅛	4¾
8	⅞	1 3/16	1½	1 13/16	2	2	2¼	2⅝	3¼	3¾	4	4	4	4⅛	4¾
10	⅞	1 3/16	1½	1 13/16	2⅛	2 7/16	2½	2¾	3¼	3¾	4¼	4¾	4¾	4¾	4¾
12	⅞	1 3/16	1½	1 13/16	2⅛	2 7/16	2¾	2¾	3¼	3¾	4¼	4¾	5¼	5¾	6¼
16	1	1 3/16	1½	1 13/16	2⅛	2 7/16	2¾	3¼	3¼	3¾	4¼	4¾	5¼	5¾	6¼
20	1	1⅜	1½	1 13/16	2⅛	2 7/16	2¾	3⅜	4	4⅝	4¾	4¾	5¼	5¾	6¼
30	.....	.....	1¾	1 13/16	2⅛	2 7/16	2⅝	3⅜	4	4⅝	5¼	5⅞	6½	6½	6½

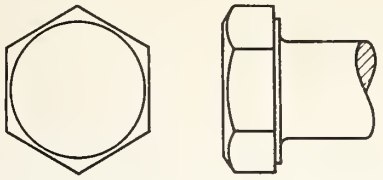
[1]For intermediate bolt lengths, the minimum thread length shall be the same as that specified in the table for the next shorter length of bolt of the same diameter.

TABLE 103.—*Dimensions of unfinished square and hexagon regular bolt heads*



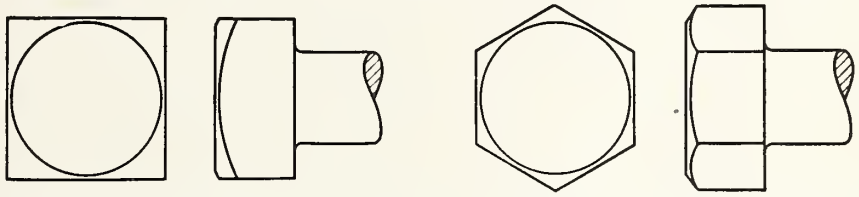
Nominal size or basic major diameter of thread	Width across flats		Width across corners, Min		Height		
	Maximum (basic)	Min	Sq	Hex.	Nominal	Max	Min
1	2	3	4	5	6	7	8
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1/4	0.2500	3/8	0.3750	0.362	0.498	0.413	1 1/64	0.188	0.156
5/16	.3125	1/2	.5000	.484	.665	.552	1 3/64	.220	.186
3/8	.3750	9/16	.5625	.544	.747	.620	1/4	.268	.232
7/16	.4375	5/8	.6250	.603	.828	.687	1 9/64	.316	.278
1/2	.5000	3/4	.7500	.725	.995	.826	2 1/64	.348	.308
9/16	.5625	7/8	.8750	.847	1.163	.966	3/8	.396	.354
5/8	.6250	15/16	.9375	.906	1.244	1.033	2 7/64	.444	.400
3/4	.7500	1 1/8	1.1250	1.088	1.494	1.240	1/2	.524	.476
7/8	.8750	1 5/16	1.3125	1.269	1.742	1.447	19/32	.620	.568
1	1.0000	1 1/2	1.5000	1.450	1.991	1.653	2 1/32	.684	.628
1 1/8	1.1250	1 11/16	1.6875	1.631	2.239	1.859	3/4	.780	.720
1 1/4	1.2500	1 7/8	1.8750	1.812	2.489	2.066	2 7/32	.876	.812
1 3/8	1.3750	2 1/16	2.0625	1.994	2.738	2.273	29/32	.940	.872
1 1/2	1.5000	2 1/4	2.2500	2.175	2.986	2.480	1	1.036	.964
1 5/8	1.6250	2 7/16	2.4375	2.356	3.235	2.686	1 3/32	1.132	1.056
1 3/4	1.7500	2 5/8	2.6250	2.538	3.485	2.893	1 5/32	1.196	1.116
1 7/8	1.8750	2 13/16	2.8125	2.719	3.733	3.100	1 1/4	1.292	1.208
2	2.0000	3	3.0000	2.900	3.982	3.306	1 11/32	1.388	1.300
2 1/4	2.2500	3 3/8	3.3750	3.262	4.479	3.719	1 1/2	1.548	1.452
2 1/2	2.5000	3 3/4	3.7500	3.625	4.977	4.133	1 21/32	1.708	1.604
2 3/4	2.7500	4 1/8	4.1250	3.988	5.476	4.546	1 13/16	1.889	1.777
3	3.0000	4 1/2	4.5000	4.350	5.973	4.959	2	2.060	1.940

TABLE 104.—*Dimensions of semifinished hexagon regular bolt heads*



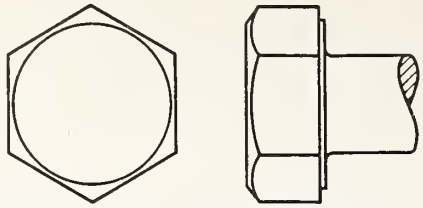
Nominal size or basic major diameter of thread	Width across flats		Width across corners	Height		
	Maximum (basic)	Min	Min	Nominal	Max	Min
1	2	3	4	5	6	7
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1/4 0.2500	3/8 0.3750	0.362	0.413	5/32	0.172	0.140
5/16 .3125	1/2 .5000	.484	.552	3/16	.205	.171
3/8 .3750	9/16 .5625	.544	.620	15/64	.252	.216
7/16 .4375	5/8 .6250	.603	.687	9/32	.300	.262
1/2 .5000	3/4 .7500	.725	.826	19/64	.317	.277
9/16 .5625	7/8 .8750	.847	.966	11/32	.365	.323
5/8 .6250	15/16 .9375	.906	1.033	25/64	.413	.369
3/4 .7500	1 1/8 1.1250	1.088	1.240	15/32	.493	.445
7/8 .8750	1 5/16 1.3125	1.269	1.447	9/16	.589	.536
1 1.0000	1 1/2 1.5000	1.450	1.653	19/32	.622	.566
1 1/8 1.1250	1 1 1/16 1.6875	1.631	1.859	11/16	.718	.658
1 1/4 1.2500	1 7/8 1.2500	1.812	2.066	25/32	.813	.749
1 3/8 1.3750	2 1/16 2.0625	1.994	2.273	27/32	.878	.810
1 1/2 1.5000	2 1/4 2.2500	2.175	2.480	15/16	.974	.902
1 5/8 1.6250	2 7/16 2.4375	2.356	2.686	1 1/32	1.069	.993
1 3/4 1.7500	2 5/8 2.6250	2.538	2.893	1 3/32	1.134	1.054
1 7/8 1.8750	2 13/16 2.8125	2.719	3.100	1 5/16	1.230	1.146
2 2.0000	3 3.0000	2.900	3.306	1 7/32	1.263	1.175
2 1/4 2.2500	3 3/8 3.3750	3.262	3.719	1 3/8	1.423	1.327
2 1/2 2.5000	3 3/4 3.7500	3.625	4.133	1 17/32	1.583	1.479
2 3/4 2.7500	4 1/8 4.1250	3.988	4.546	1 1 1/16	1.744	1.632
3 3.0000	4 1/2 4.5000	4.350	4.959	1 7/8	1.935	1.815

TABLE 105.—*Dimensions of unfinished square and hexagon heavy bolt heads*



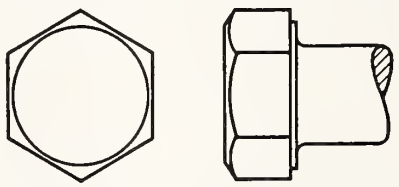
Nominal size or basic major diameter of thread	Width across flats		Width across corners (min)		Height		
	Maximum (basic)	Min	Sq	Hex.	Nominal	Max	Min
1	2	3	4	5	6	7	8
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1/2 0.5000	7/8 0.8750	0.850	1.167	0.969	7/16	0.458	0.418
9/16 .5625	15/16 .9375	.909	1.249	1.037	15/32	.490	.448
5/8 .6250	1 1/16 1.0625	1.031	1.416	1.175	17/32	.553	.509
3/4 .7500	1 1/4 1.2500	1.212	1.665	1.382	5/8	.649	.601
7/8 .8750	1 7/16 1.4375	1.394	1.914	1.589	23/32	.745	.693
1 1.0000	1 5/8 1.6250	1.575	2.162	1.796	13/16	.840	.784
1 1/8 1.1250	1 13/16 1.8125	1.756	2.411	2.002	29/32	.936	.876
1 1/4 1.2500	2 2.0000	1.938	2.661	2.209	1	1.032	.968
1 3/8 1.3750	2 3/16 2.1875	2.119	2.909	2.416	1 3/32	1.128	1.060
1 1/2 1.5000	2 3/8 2.3750	2.300	3.158	2.622	1 3/16	1.224	1.152
1 5/8 1.6250	2 9/16 2.5625	2.481	3.406	2.828	1 9/32	1.319	1.243
1 3/4 1.7500	2 3/4 2.7500	2.662	3.655	3.035	1 3/8	1.415	1.335
1 7/8 1.8750	2 15/16 2.9375	2.844	3.905	3.242	1 15/32	1.511	1.427
2 2.0000	3 1/16 3.1250	3.025	4.153	3.449	1 9/16	1.606	1.518
2 1/4 2.2500	3 1/2 3.5000	3.388	4.652	3.862	1 3/4	1.798	1.702
2 1/2 2.5000	3 7/8 3.8750	3.750	5.149	4.275	1 15/16	1.990	1.886
2 3/4 2.7500	4 1/4 4.2500	4.112	5.646	4.688	2 1/8	2.181	2.069
3 3.0000	4 5/8 4.6250	4.475	6.144	5.102	2 5/16	2.373	2.252

TABLE 106.—*Dimensions of semifinished hexagon heavy bolt heads*



Nominal size or basic major diameter of thread	Width across flats		Width across corners	Height		
	Maximum (basic)	Min	Min	Nominal	Max	Min
1	2	3	4	5	6	7
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1/2	0.5000	7/8	0.8750	0.850	0.969	13/32	0.426	0.386
9/16	.5625	15/16	.9375	.909	1.037	7/16	.459	.417
5/8	.6250	1 1/16	1.0625	1.031	1.175	1/2	.522	.478
3/4	.7500	1 1/4	1.2500	1.212	1.382	19/32	.618	.570
7/8	.8750	1 7/16	1.4375	1.394	1.589	11/16	.714	.662
1	1.0000	1 5/8	1.6250	1.575	1.796	3/4	.778	.722
1 1/8	1.1250	1 13/16	1.8125	1.756	2.002	27/32	.874	.814
1 1/4	1.2500	2	2.0000	1.938	2.209	15/16	.970	.906
1 3/8	1.3750	2 3/16	2.1875	2.119	2.416	1 1/32	1.065	.997
1 1/2	1.5000	2 3/8	2.3750	2.300	2.622	1 1/8	1.161	1.089
1 5/8	1.6250	2 9/16	2.5625	2.481	2.828	1 7/32	1.257	1.181
1 3/4	1.7500	2 3/4	2.7500	2.662	3.035	1 5/16	1.352	1.272
1 7/8	1.8750	2 15/16	2.9375	2.844	3.242	1 13/32	1.448	1.364
2	2.0000	3 1/8	3.1250	3.025	3.449	1 7/16	1.482	1.394
2 1/4	2.2500	3 1/2	3.5000	3.388	3.862	1 5/8	1.673	1.577
2 1/2	2.5000	3 7/8	3.8750	3.750	4.275	1 13/16	1.864	1.760
2 3/4	2.7500	4 1/4	4.2500	4.112	4.688	2	2.056	1.944
3	3.0000	4 5/8	4.6250	4.475	5.102	2 3/16	2.248	2.128

TABLE 107.—*Dimensions of finished hexagon cap screw heads*



Nominal size or basic major diameter of thread	Width across flats		Width across corners	Height		
	Maximum (basic)	Min	Min	Nominal	Max	Min
1	2	3	4	5	6	7
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1/4	0.2500	7/16	0.4375	0.428	0.488	3/16	0.194	0.181
5/16	.3125	1/2	.5000	.489	.557	15/64	.242	.227
3/8	.3750	9/16	.5625	.551	.628	9/32	.289	.273
7/16	.4375	5/8	.6250	.612	.698	21/64	.338	.319
1/2	.5000	3/4	.7500	.736	.840	3/8	.386	.364
9/16	.5625	13/16	.8125	.798	.910	27/64	.433	.410
5/8	.6250	7/8	.8750	.860	.980	15/32	.481	.456
3/4	.7500	1	1.0000	.983	1.121	9/16	.577	.548
7/8	.8750	1 1/8	1.1250	1.106	1.261	21/32	.672	.640
1	1.0000	1 5/16	1.3125	1.292	1.473	3/4	.768	.732
1 1/8	1.1250	1 1/2	1.5000	1.477	1.684	27/32	.864	.824
1 1/4	1.2500	1 11/16	1.6875	1.663	1.896	15/16	.959	.916

4. RECOMMENDED REQUIREMENTS, NUTS

(*a*) WORKMANSHIP.—The workmanship shall be compatible with the type of product and class of fit and finish specified. The product shall be free from abnormal scale, fins, seams, or other defects. All nuts shall be free from any defects which might affect their serviceability.

Unless otherwise specified, semifinished nuts shall be either cold-punched, hot-forged and trimmed, or machined from bar stock. Unfinished nuts may be cold- or hot-punched or hot-forged.

(*b*) THREAD SERIES.—When nuts are furnished with bolts, the threads of the nuts shall, unless otherwise specified, be of the same thread series and class of fit as the threads of the bolts. When nuts are ordered separately, the threads shall be of the thread series and class of fit specified.

(*c*) DETAILS OF DESIGN.—1. *Taper of nuts.*—The taper of the sides of nuts (the angle between one side and the axis) shall not exceed 2°. The largest width shall not exceed the specified maximum width across flats.

2. *Top of nuts.*—The tops of all nuts, except light castle nuts, shall be flat and chamfered, but unfinished nuts (except jam nuts) may be washer crowned. The angle of chamfer with the top surface shall be 30° for hexagonal nuts and 25° for square nuts, and the diameter of the top circle shall be the maximum width across flats, within a tolerance of minus 15 percent.

3. *Bearing surface.*—(*a*) *Unfinished nuts.*—The bearing surface of unfinished nuts shall be at right angles to the axis of the threaded hole within a tolerance of 3° for 1-in. nuts or smaller, and 2° for nuts larger than 1 in.

(*b*) *Semifinished nuts.*—The bearing surface of semifinished nuts shall be washer faced or have chamfered corners. The thickness of the washer face shall be approximately $\frac{1}{64}$ in. included in the nut thickness, and the diameter of the washer face shall be the maximum width across flats within a tolerance of minus 5 percent.

The bearing surface shall be at right angles to the axis of the threaded hole within a tolerance of 2° for $\frac{5}{8}$-in. nuts or smaller, and 1° for nuts larger than $\frac{5}{8}$ in.

5. TABLES OF DIMENSIONS, NUTS

(*a*) REGULAR NUTS AND REGULAR JAM NUTS.—1. *Unfinished square and hexagon.*—The dimensions of unfinished square and hexagon regular jam nuts shall conform to table 108.

2. *Semifinished hexagon.*—The dimensions of semifinished hexagon regular nuts and regular jams nuts shall conform to table 109.

3. *Semifinished hexagon slotted.*—The dimensions of semifinished hexagon regular slotted nuts shall conform to table 110. Slots may have square or round bottoms at the option of the manufacturer.

(*b*) HEAVY NUTS AND HEAVY JAM NUTS.—1. *Unfinished square and hexagon.*—The dimensions of unfinished square and hexagon heavy nuts and hexagon heavy jam nuts shall conform to table 111.

2. *Semifinished hexagon.*—The dimensions of semifinished hexagon heavy nuts and jam nuts shall conform to table 112.

3. *Semifinished hexagon slotted.*—The dimensions of semifinished hexagon heavy slotted nuts shall conform to table 113.

(*c*) LIGHT NUTS AND LIGHT JAM NUTS.—1. *Semifinished hexagon.*—The dimensions of semifinished hexagon light nuts and light jam nuts shall conform to table 114.

2. *Semifinished hexagon thick.*—The dimensions of semifinished hexagon light thick nuts shall conform to table 115.

3. *Semifinished hexagon slotted.*—The dimensions of semifinished hexagon light slotted nuts shall conform to table 116.

4. *Semifinished hexagon thick slotted.*—The dimensions of semifinished hexagon light thick slotted nuts shall conform to table 117.

5. *Semifinished hexagon castle.*—The dimensions of semifinished hexagon light castle nuts shall conform to table 118.

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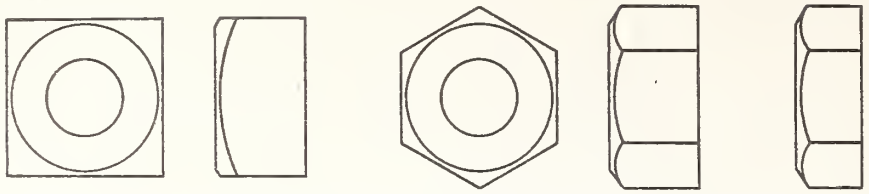
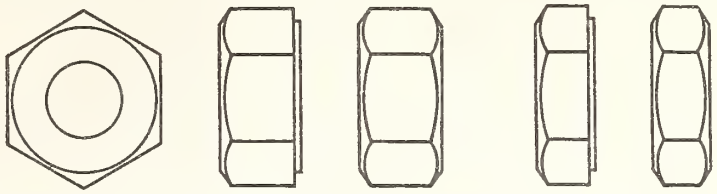
TABLE 108.—*Dimensions of unfinished square and hexagon regular nuts and hexagon regular jam nuts*



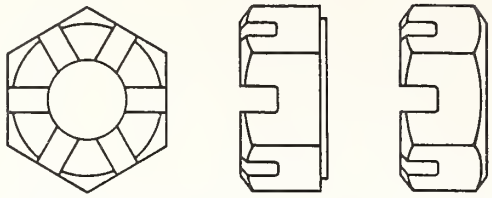
Nominal size or basic major diameter of thread	Width across flats		Width across corners, min		Thickness, regular nuts			Thickness, regular jam nuts		
	Maximum (basic)	Minimum	Square	Hexagon	Nominal	Maximum	Minimum	Nominal	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10	11
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
¼.....0.2500	7/16.....0.4375	0.425	0.584	0.484	7/32	0.235	0.203	5/32	0.172	0.140
5/16..... .3125	9/16..... .5625	.547	.751	.624	17/64	.283	.249	3/16	.204	.170
3/8..... .3750	5/8..... .6250	.606	.832	.691	21/64	.346	.310	7/32	.237	.201
7/16..... .4375	3/4..... .7500	.728	1.000	.830	3/8	.394	.356	1/4	.269	.231
½..... .5000	13/16..... .8125	.788	1.082	.898	7/16	.458	.418	5/16	.332	.292
9/16..... .5625	7/8..... .8750	.847	1.163	.966	½	.521	.479	11/32	.365	.323
5/8..... .6250	1.....1.0000	.969	1.330	1.104	35/64	.569	.525	3/8	.397	.353
3/4..... .7500	1 1/8.....1.1250	1.088	1.494	1.240	21/32	.680	.632	7/16	.462	.414
7/8..... .8750	1 5/16.....1.3125	1.269	1.742	1.447	49/64	.792	.740	½	.526	.474
1.....1.0000	1½.....1.5000	1.450	1.991	1.653	7/8	.903	.847	9/16	.590	.534
1⅛.....1.1250	1 11/16.....1.6875	1.631	2.239	1.859	1	1.030	.970	5/8	.655	.595
1¼.....1.2500	1 7/8.....1.8750	1.812	2.489	2.066	1 3/32	1.126	1.062	3/4	.782	.718
1 3/8.....1.3750	2 1/16.....2.0625	1.994	2.738	2.273	1 13/64	1.237	1.169	13/16	.846	.778
1½.....1.5000	2¼.....2.2500	2.175	2.986	2.480	1 5/16	1.348	1.276	7/8	.911	.839
1 5/8.....1.6250	2 7/16.....2.4375	2.356	3.235	2.686	1 27/64	1.460	1.384	15/16	.976	.900
1¾.....1.7500	2 5/8.....2.6250	2.538	3.485	2.893	1 17/32	1.571	1.491	1	1.040	.960
1 7/8.....1.8750	2 13/16.....2.8125	2.719	3.733	3.100	1 41/64	1.683	1.599	1 1/16	1.104	1.020
2.....2.0000	3.....3.0000	2.900	3.982	3.306	1¾	1.794	1.706	1 1/8	1.169	1.081
2¼.....2.2500	3 3/8.....3.3750	3.262	4.479	3.719	1 31/32	2.017	1.921	1¼	1.298	1.202
2½.....2.5000	3¾.....3.7500	3.625	4.977	4.133	2 3/16	2.240	2.136	1½	1.552	1.448
2¾.....2.7500	4⅛.....4.1250	3.988	5.476	4.546	2 13/32	2.462	2.350	1 5/8	1.681	1.569
3.....3.0000	4½.....4.5000	4.350	5.973	4.959	2 5/8	2.685	2.565	1¾	1.810	1.690

TABLE 109.—*Dimensions of semifinished hexagon regular nuts and hexagon regular jam nuts*



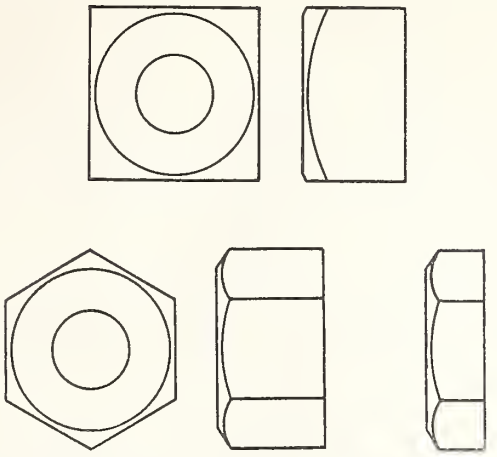
Nominal size or basic major diameter of thread	Width across flats		Width across corners	Thickness, regular nuts			Thickness, regular jam nuts		
	Maximum (basic)	Minimum	Minimum	Nominal	Maximum	Minimum	Nominal	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1/4 ..... 0.2500	7/16 ..... 0.4375	0.425	0.484	13/64	0.219	0.187	9/64	0.157	0.125
5/16 ..... .3125	9/16 ..... .5625	.547	.624	1/4	.267	.233	11/64	.189	.155
3/8 ..... .3750	5/8 ..... .6250	.606	.691	5/16	.330	.294	13/64	.221	.185
7/16 ..... .4375	3/4 ..... .7500	.728	.830	23/64	.378	.340	15/64	.253	.215
1/2 ..... .5000	13/16 ..... .8125	.788	.898	27/64	.442	.402	19/64	.317	.277
9/16 ..... .5625	7/8 ..... .8750	.847	.966	31/64	.505	.463	21/64	.349	.307
5/8 ..... .6250	1 ..... 1.0000	.969	1.104	17/32	.553	.509	23/64	.381	.337
3/4 ..... .7500	1 1/8 ..... 1.1250	1.088	1.240	41/64	.665	.617	27/64	.446	.398
7/8 ..... .8750	1 5/16 ..... 1.3125	1.269	1.447	3/4	.776	.724	31/64	.510	.458
1 ..... 1.0000	1 1/2 ..... 1.5000	1.450	1.653	55/64	.887	.831	35/64	.575	.519
1 1/8 ..... 1.1250	1 11/16 ..... 1.6875	1.631	1.859	31/32	.999	.939	39/64	.639	.579
1 1/4 ..... 1.2500	1 7/8 ..... 1.8750	1.812	2.066	1 1/16	1.094	1.030	23/32	.751	.687
1 3/8 ..... 1.3750	2 1/16 ..... 2.0625	1.994	2.273	1 1/64	1.206	1.138	25/32	.815	.747
1 1/2 ..... 1.5000	2 1/4 ..... 2.2500	2.175	2.480	1 9/32	1.317	1.245	27/32	.880	.808
1 5/8 ..... 1.6250	2 7/16 ..... 2.4375	2.356	2.686	1 25/64	1.429	1.353	29/32	.944	.868
1 3/4 ..... 1.7500	2 5/8 ..... 2.6250	2.538	2.893	1 1/2	1.540	1.460	31/32	1.009	.929
1 7/8 ..... 1.8750	2 13/16 ..... 2.8125	2.719	3.100	1 39/64	1.651	1.567	1 1/32	1.073	.989
2 ..... 2.0000	3 ..... 3.0000	2.900	3.306	1 23/32	1.763	1.675	1 3/32	1.138	1.050
2 1/4 ..... 2.2500	3 3/8 ..... 3.3750	3.262	3.719	1 59/64	1.970	1.874	1 13/64	1.251	1.155
2 1/2 ..... 2.5000	3 3/4 ..... 3.7500	3.625	4.133	2 9/64	2.193	2.089	1 29/64	1.505	1.401
2 3/4 ..... 2.7500	4 1/8 ..... 4.1250	3.988	4.546	2 23/64	2.415	2.303	1 37/64	1.634	1.522
3 ..... 3.0000	4 1/2 ..... 4.5000	4.350	4.959	2 37/64	2.638	2.518	1 45/64	1.763	1.643

TABLE 110.—*Dimensions of semifinished hexagon regular slotted nuts*



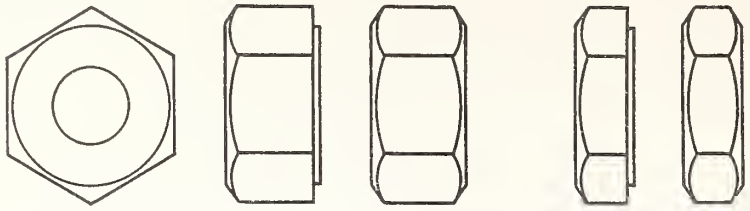
Nominal size or basic major diameter of thread	Width across flats		Width across corners	Thickness			Slot	
	Maximum (basic)	Minimum	Minimum	Nominal	Maximum	Minimum	Width	Depth
1	2	3	4	5	6	7	8	9
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
¼ 0.2500	7/16 0.4375	0.425	0.484	13/64	0.219	0.187	5/64	3/32
5/16 .3125	9/16 .5625	.547	.624	1/4	.267	.233	3/32	3/32
3/8 .3750	5/8 .6250	.606	.691	5/16	.330	.294	1/8	1/8
7/16 .4375	3/4 .7500	.728	.830	23/64	.378	.340	1/8	5/32
1/2 .5000	13/16 .8125	.788	.898	27/64	.442	.402	5/32	5/32
9/16 .5625	7/8 .8750	.847	.966	31/64	.505	.463	5/32	3/16
5/8 .6250	1.0000	.969	1.104	17/32	.553	.509	3/16	7/32
3/4 .7500	1 1/8 1.1250	1.088	1.240	41/64	.665	.617	3/16	1/4
7/8 .8750	1 5/16 1.3125	1.269	1.447	3/4	.776	.724	3/16	1/4
1.0000	1 1/2 1.5000	1.450	1.653	55/64	.887	.831	1/4	9/32
1 1/8 1.1250	1 11/16 1.6875	1.631	1.859	31/32	.999	.939	1/4	11/32
1 1/4 1.2500	1 7/8 1.8750	1.812	2.066	1 1/16	1.094	1.030	5/16	3/8
1 3/8 1.3750	2 1/16 2.0625	1.994	2.273	1 1/64	1.206	1.138	5/16	3/8
1 1/2 1.5000	2 1/4 2.2500	2.175	2.480	1 9/32	1.317	1.245	3/8	7/16
1 5/8 1.6250	2 7/16 2.4375	2.356	2.686	1 25/64	1.429	1.353	3/8	7/16
1 3/4 1.7500	2 5/8 2.6250	2.538	2.893	1 1/2	1.540	1.460	7/16	1/2
1 7/8 1.8750	2 13/16 2.8125	2.719	3.100	1 39/64	1.651	1.567	7/16	9/16
2.0000	3.0000	2.900	3.306	1 23/32	1.763	1.675	7/16	9/16
2 1/4 2.2500	3 3/8 3.3750	3.262	3.719	1 59/64	1.970	1.874	7/16	9/16
2 1/2 2.5000	3 3/4 3.7500	3.625	4.133	2 9/64	2.193	2.089	9/16	11/16
2 3/4 2.7500	4 1/8 4.1250	3.988	4.546	2 23/64	2.415	2.303	9/16	1 1/16
3.0000	4 1/2 4.5000	4.350	4.959	2 37/64	2.638	2.518	5/8	3/4

TABLE 111.—*Dimensions of unfinished square and hexagon heavy nuts and hexagon heavy jam nuts*



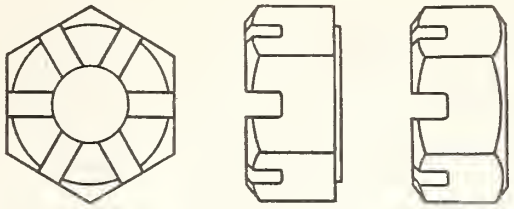
Nominal size or basic major diameter of thread	Width across flats		Width across corners, min.		Thickness, heavy nuts			Thickness, heavy jam nuts		
	Maximum (basic)	Minimum	Square	Hexagon	Nominal	Maximum	Minimum	Nominal	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10	11
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1/4.....0.2500	1/2.....0.5000	0.488	0.670	0.556	1/4	0.266	0.234	3/16	0.204	0.172
5/16..... .3125	19/32..... .5938	.578	.794	.659	5/16	.330	.296	7/32	.236	.202
3/8..... .3750	11/16..... .6875	.669	.919	.763	3/8	.393	.357	1/4	.268	.232
7/16..... .4375	25/32..... .7812	.759	1.042	.865	7/16	.456	.418	9/32	.300	.262
1/2..... .5000	7/8..... .8750	.850	1.167	.969	1/2	.520	.480	5/16	.332	.292
9/16..... .5625	15/16..... .9375	.909	1.249	1.037	9/16	.584	.542	11/32	.365	.323
5/8..... .6250	1 1/16.....1.0625	1.031	1.416	1.175	5/8	.647	.603	3/8	.397	.353
3/4..... .7500	1 1/4.....1.2500	1.212	1.665	1.382	3/4	.774	.726	7/16	.462	.414
7/8..... .8750	1 7/16.....1.4375	1.394	1.914	1.589	7/8	.901	.849	1/2	.526	.474
1.....1.0000	1 5/8.....1.6250	1.575	2.162	1.796	1	1.028	.972	9/16	.590	.534
1 1/8.....1.1250	1 13/16.....1.8125	1.756	2.411	2.002	1 1/8	1.155	1.095	5/8	.655	.595
1 1/4.....1.2500	2.....2.0000	1.938	2.661	2.209	1 1/4	1.282	1.218	3/4	.782	.718
1 3/8.....1.3750	2 3/16.....2.1875	2.119	2.909	2.416	1 3/8	1.409	1.341	13/16	.846	.778
1 1/2.....1.5000	2 3/8.....2.3750	2.300	3.158	2.622	1 1/2	1.536	1.464	7/8	.911	.839
1 5/8.....1.6250	2 9/16.....2.5625	2.481	3.406	2.828	1 5/8	1.663	1.587	15/16	.976	.900
1 3/4.....1.7500	2 3/4.....2.7500	2.662	3.655	3.035	1 3/4	1.790	1.710	1	1.040	.960
1 7/8.....1.8750	2 15/16.....2.9375	2.844	3.905	3.242	1 7/8	1.917	1.833	1 1/16	1.104	1.020
2.....2.0000	3 1/8.....3.1250	3.025	4.153	3.449	2	2.044	1.956	1 1/8	1.169	1.081
2 1/4.....2.2500	3 1/2.....3.5000	3.388	4.652	3.862	2 1/4	2.298	2.202	1 1/4	1.298	1.202
2 1/2.....2.5000	3 7/8.....3.8750	3.750	5.149	4.275	2 1/2	2.552	2.448	1 1/2	1.552	1.448
2 3/4.....2.7500	4 1/4.....4.2500	4.112	5.646	4.688	2 3/4	2.806	2.694	1 5/8	1.681	1.569
3.....3.0000	4 5/8.....4.6250	4.475	6.144	5.102	3	3.060	2.940	1 3/4	1.810	1.690
3 1/4.....3.2500	5.....5.0000	4.838	6.643	5.515	3 1/4	3.314	3.186	1 7/8	1.939	1.811
3 1/2.....3.5000	5 3/8.....5.3750	5.200	7.140	5.928	3 1/2	3.568	3.432	2	2.068	1.932
3 3/4.....3.7500	5 3/4.....5.7500	5.562	7.637	6.341	3 3/4	3.822	3.678	2 1/8	2.197	2.053
4.....4.0000	6 1/8.....6.1250	5.925	8.135	6.755	4	4.076	3.924	2 1/4	2.326	2.174

TABLE 112.—*Dimensions of semifinished hexagon heavy nuts and heavy jam nuts*



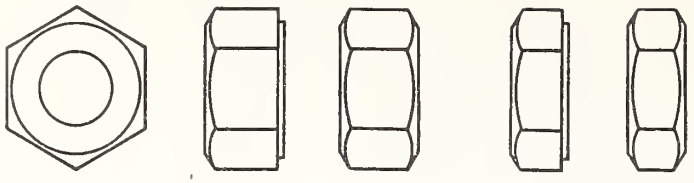
Nominal size or basic major diameter of thread	Width across flats		Width across corners	Thickness, heavy nuts			Thickness, heavy jam nuts		
	Maximum (basic)	Minimum	Minimum	Nominal	Maximum	Minimum	Nominal	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1/4 ..... 0.2500	1/2 ..... 0.5000	0.488	0.556	15/64	0.250	0.218	11/64	0.188	0.156
5/16 ..... .3125	19/32 ..... .5938	.578	.659	19/64	.314	.280	13/64	.220	.186
3/8 ..... .3750	11/16 ..... .6875	.669	.763	23/64	.377	.341	15/64	.252	.216
7/16 ..... .4375	25/32 ..... .7812	.759	.865	27/64	.441	.403	17/64	.285	.247
1/2 ..... .5000	7/8 ..... .8750	.850	.969	31/64	.504	.464	19/64	.317	.277
9/16 ..... .5625	15/16 ..... .9375	.909	1.037	35/64	.568	.526	21/64	.349	.307
5/8 ..... .6250	1 1/16 ..... 1.0625	1.031	1.175	39/64	.631	.587	23/64	.381	.337
3/4 ..... .7500	1 1/4 ..... 1.2500	1.212	1.382	47/64	.758	.710	27/64	.446	.398
7/8 ..... .8750	1 7/16 ..... 1.4375	1.394	1.589	55/64	.885	.833	31/64	.510	.458
1 ..... 1.0000	1 5/8 ..... 1.6250	1.575	1.796	63/64	1.012	.956	35/64	.575	.519
1 1/8 ..... 1.1250	1 13/16 ..... 1.8125	1.756	2.002	1 7/64	1.139	1.079	39/64	.639	.579
1 1/4 ..... 1.2500	2 ..... 2.0000	1.938	2.209	1 7/32	1.251	1.187	23/32	.751	.687
1 3/8 ..... 1.3750	2 3/16 ..... 2.1875	2.119	2.416	1 11/32	1.378	1.310	25/32	.815	.747
1 1/2 ..... 1.5000	2 3/8 ..... 2.3750	2.300	2.622	1 15/32	1.505	1.433	27/32	.880	.808
1 5/8 ..... 1.6250	2 9/16 ..... 2.5625	2.481	2.828	1 19/32	1.632	1.556	29/32	.944	.868
1 3/4 ..... 1.7500	2 3/4 ..... 2.7500	2.662	3.035	1 23/32	1.759	1.679	31/32	1.009	.929
1 7/8 ..... 1.8750	2 15/16 ..... 2.9375	2.844	3.242	1 27/32	1.886	1.802	1 1/32	1.073	.989
2 ..... 2.0000	3 1/8 ..... 3.1250	3.025	3.449	1 31/32	2.013	1.925	1 3/32	1.138	1.050
2 1/4 ..... 2.2500	3 1/2 ..... 3.5000	3.388	3.862	2 13/64	2.251	2.155	1 13/64	1.251	1.155
2 1/2 ..... 2.5000	3 7/8 ..... 3.8750	3.750	4.275	2 29/64	2.505	2.401	1 29/64	1.505	1.401
2 3/4 ..... 2.7500	4 1/4 ..... 4.2500	4.112	4.688	2 45/64	2.759	2.647	1 37/64	1.634	1.522
3 ..... 3.0000	4 5/8 ..... 4.6250	4.475	5.102	2 61/64	3.013	2.893	1 45/64	1.763	1.643
3 1/4 ..... 3.2500	5 ..... 5.0000	4.838	5.515	3 3/16	3.252	3.124	1 13/16	1.876	1.748
3 1/2 ..... 3.5000	5 3/8 ..... 5.3750	5.200	5.928	3 7/16	3.506	3.370	1 15/16	2.006	1.870
3 3/4 ..... 3.7500	5 3/4 ..... 5.7500	5.562	6.341	3 11/16	3.760	3.616	2 1/16	2.134	1.990
4 ..... 4.0000	6 1/8 ..... 6.1250	5.925	6.755	3 15/16	4.014	3.862	2 3/16	2.264	2.112

TABLE 113.—*Dimensions of semifinished hexagon heavy slotted nuts*



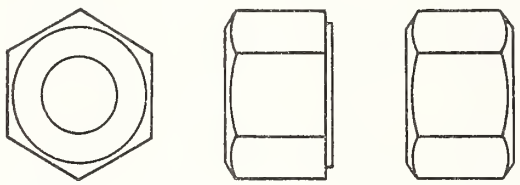
Nominal size or basic major diameter of thread	Width across flats		Width across corners	Thickness			Slot	
	Maximum (basic)	Minimum	Minimum	Nominal	Maximum	Minimum	Width	Depth
1	2	3	4	5	6	7	8	9
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inch*	*Inch*
1/4 ..... 0.2500	1/2 ..... 0.5000	0.488	0.556	15/64	0.250	0.218	5/64	3/32
5/16 ..... .3125	19/32 ..... .5938	.578	.659	19/64	.314	.280	3/32	3/32
3/8 ..... .3750	11/16 ..... .6875	.669	.763	23/64	.377	.341	1/8	1/8
7/16 ..... .4375	25/32 ..... .7812	.759	.865	27/64	.441	.403	1/8	5/32
1/2 ..... .5000	7/8 ..... .8750	.850	.969	31/64	.504	.464	5/32	5/32
9/16 ..... .5625	15/16 ..... .9375	.909	1.037	35/64	.568	.526	5/32	3/16
5/8 ..... .6250	1 1/16 ..... 1.0625	1.031	1.175	39/64	.631	.587	3/16	7/32
3/4 ..... .7500	1 1/4 ..... 1.2500	1.212	1.382	47/64	.758	.710	3/16	1/4
7/8 ..... .8750	1 7/16 ..... 1.4375	1.394	1.589	55/64	.885	.833	3/16	1/4
1 ..... 1.0000	1 5/8 ..... 1.6250	1.575	1.796	63/64	1.012	.956	1/4	9/32
1 1/8 ..... 1.1250	1 13/16 ..... 1.8125	1.756	2.002	1 7/64	1.139	1.079	1/4	11/32
1 1/4 ..... 1.2500	2 ..... 2.0000	1.938	2.209	1 7/32	1.251	1.187	5/16	3/8
1 3/8 ..... 1.3750	2 3/16 ..... 2.1875	2.119	2.416	1 11/32	1.378	1.310	5/16	3/8
1 1/2 ..... 1.5000	2 3/8 ..... 2.3750	2.300	2.622	1 15/32	1.505	1.433	3/8	7/16
1 5/8 ..... 1.6250	2 9/16 ..... 2.5625	2.481	2.828	1 19/32	1.632	1.556	3/8	7/16
1 3/4 ..... 1.7500	2 3/4 ..... 2.7500	2.662	3.035	1 23/32	1.759	1.679	7/16	1/2
1 7/8 ..... 1.8750	2 15/16 ..... 2.9375	2.844	3.242	1 27/32	1.886	1.802	7/16	9/16
2 ..... 2.0000	3 1/8 ..... 3.1250	3.025	3.449	1 31/32	2.013	1.925	7/16	9/16
2 1/4 ..... 2.2500	3 1/2 ..... 3.5000	3.388	3.862	2 13/64	2.251	2.155	7/16	9/16
2 1/2 ..... 2.5000	3 7/8 ..... 3.8750	3.750	4.275	2 29/64	2.505	2.401	7/16	11/16
2 3/4 ..... 2.7500	4 1/4 ..... 4.2500	4.112	4.688	2 45/64	2.759	2.647	9/16	11/16
3 ..... 3.0000	4 5/8 ..... 4.6250	4.475	5.102	2 61/64	3.013	2.893	5/8	3/4
3 1/4 ..... 3.2500	5 ..... 5.0000	4.838	5.515	3 3/16	3.252	3.124	5/8	3/4
3 1/2 ..... 3.5000	5 3/8 ..... 5.3750	5.200	5.928	3 7/16	3.506	3.370	5/8	3/4
3 3/4 ..... 3.7500	5 3/4 ..... 5.7500	5.562	6.341	3 11/16	3.760	3.616	5/8	3/4
4 ..... 4.0000	6 1/8 ..... 6.1250	5.925	6.755	3 15/16	4.014	3.862	5/8	3/4

TABLE 114.—*Dimensions of semifinished hexagon light nuts and light jam nuts*



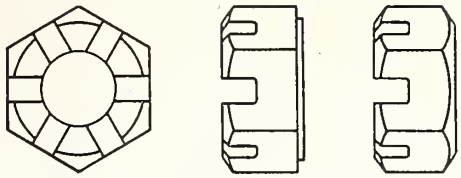
Nominal size or basic major diameter of thread	Width across flats		Width across corners	Thickness, light nuts			Thickness, light jam nuts		
	Maximum (basic)	Minimum	Minimum	Nominal	Maximum	Minimum	Nominal	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inch*	*Inch*	*Inch*
1/4 ..... 0.2500	7/16 ..... 0.4375	0.428	0.488	7/32	0.226	0.212	5/32	0.163	0.150
5/16 ..... .3125	1/2 ..... .5000	.489	.557	17/64	.273	.258	3/16	.195	.180
3/8 ..... .3750	9/16 ..... .5625	.551	.628	21/64	.337	.320	7/32	.227	.210
7/16 ..... .4375	5/8 ..... .6250	.612	.698	3/8	.385	.365	1/4	.260	.240
1/2 ..... .5000	3/4 ..... .7500	.736	.840	7/16	.448	.427	5/16	.323	.302
9/16 ..... .5625	7/8 ..... .8750	.861	.982	31/64	.496	.473	5/16	.324	.301
5/8 ..... .6250	15/16 ..... .9375	.922	1.051	35/64	.559	.534	3/8	.387	.363
3/4 ..... .7500	1 1/16 ..... 1.0625	1.045	1.191	21/32	.670	.642	3/8	.389	.361
7/8 ..... .8750	1 1/4 ..... 1.2500	1.231	1.403	49/64	.782	.750	7/16	.454	.421
1 ..... 1.0000	1 7/16 ..... 1.4375	1.417	1.615	7/8	.893	.857	1/2	.518	.482
1 1/8 ..... 1.1250	1 5/8 ..... 1.6250	1.602	1.826	63/64	1.004	.964	9/16	.582	.543
1 1/4 ..... 1.2500	1 13/16 ..... 1.8125	1.788	2.038	1 1/32	1.116	1.072	5/8	.647	.603
1 3/8 ..... 1.3750	2 ..... 2.0000	1.973	2.249	1 13/64	1.227	1.180	3/4	.774	.726
1 1/2 ..... 1.5000	2 3/16 ..... 2.1875	2.159	2.461	1 5/16	1.338	1.287	13/16	.838	.787

TABLE 115.—*Dimensions of semifinished hexagon light thick nuts*



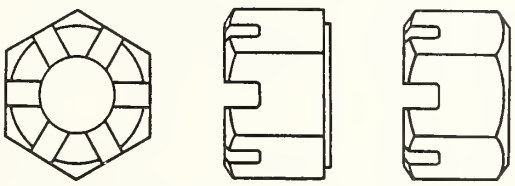
Nominal size or basic major diameter of thread	Width across flats		Width across corners	Thickness		
	Maximum (basic)	Minimum	Minimum	Nominal	Maximum	Minimum
1	2	3	4	5	6	7
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1/4 ..... 0.2500	7/16 ..... 0.4375	0.428	0.488	9/32	0.288	0.274
5/16 ..... .3125	1/2 ..... .5000	.489	.557	21/64	.336	.320
3/8 ..... .3750	9/16 ..... .5625	.551	.628	13/32	.415	.398
7/16 ..... .4375	5/8 ..... .6250	.612	.698	29/64	.463	.444
1/2 ..... .5000	3/4 ..... .7500	.736	.840	9/16	.573	.552
9/16 ..... .5625	7/8 ..... .8750	.861	.982	39/64	.621	.598
5/8 ..... .6250	15/16 ..... .9375	.922	1.051	23/32	.731	.706
3/4 ..... .7500	1 1/16 ..... 1.0625	1.045	1.191	13/16	.827	.798
7/8 ..... .8750	1 1/4 ..... 1.2500	1.231	1.403	29/32	.922	.890
1 ..... 1.0000	1 7/16 ..... 1.4375	1.417	1.615	1	1.018	.982
1 1/8 ..... 1.1250	1 5/8 ..... 1.6250	1.602	1.826	1 5/32	1.176	1.136
1 1/4 ..... 1.2500	1 13/16 ..... 1.8125	1.788	2.038	1 1/4	1.272	1.228
1 3/8 ..... 1.3750	2 ..... 2.0000	1.973	2.249	1 3/8	1.399	1.351
1 1/2 ..... 1.5000	2 3/16 ..... 2.1875	2.159	2.461	1 1/2	1.526	1.474

TABLE 116.—*Dimensions of semifinished hexagon light slotted nuts*



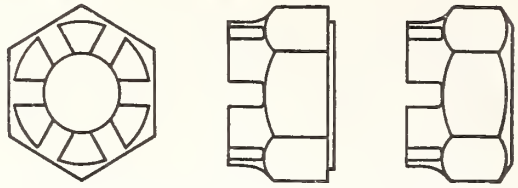
Nominal size or basic major diameter of thread	Width across flats		Width across corners	Thickness			Slot	
	Maximum (basic)	Minimum	Minimum	Nominal	Maximum	Minimum	Width	Depth
1	2	3	4	5	6	7	8	9
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inch*	*Inch*
1/4 ..... 0.2500	7/16 ..... 0.4375	0.428	0.488	7/32	0.226	0.212	5/64	3/32
5/16 ..... .3125	1/2 ..... .5000	.489	.557	17/64	.273	.258	3/32	3/32
3/8 ..... .3750	9/16 ..... .5625	.551	.628	21/64	.337	.320	1/8	1/8
7/16 ..... .4375	5/8 ..... .6250	.612	.698	3/8	.385	.365	1/8	5/32
1/2 ..... .5000	3/4 ..... .7500	.736	.840	7/16	.448	.427	5/32	5/32
9/16 ..... .5625	7/8 ..... .8750	.861	.982	31/64	.496	.473	5/32	3/16
5/8 ..... .6250	15/16 ..... .9375	.922	1.051	35/64	.559	.534	3/16	7/32
3/4 ..... .7500	1 1/16 ..... 1.0625	1.045	1.191	21/32	.670	.642	3/16	1/4
7/8 ..... .8750	1 1/4 ..... 1.2500	1.231	1.403	49/64	.782	.750	3/16	1/4
1 ..... 1.0000	1 7/16 ..... 1.4375	1.417	1.615	7/8	.893	.857	1/4	9/32
1 1/8 ..... 1.1250	1 5/8 ..... 1.6250	1.602	1.826	63/64	1.004	.964	1/4	11/32
1 1/4 ..... 1.2500	1 13/16 ..... 1.8125	1.788	2.038	1 3/32	1.116	1.072	5/16	3/8
1 3/8 ..... 1.3750	2 ..... 2.0000	1.973	2.249	1 13/64	1.227	1.180	5/16	3/8
1 1/2 ..... 1.5000	2 3/16 ..... 2.1875	2.159	2.461	1 5/16	1.338	1.287	3/8	7/16

TABLE 117.—*Dimensions of semifinished hexagon light thick slotted nuts*



Nominal size or basic major diameter of thread	Width across flats		Width across corners	Thickness			Slot	
	Maximum (basic)	Minimum	Minimum	Nominal	Maximum	Minimum	Width	Depth
1	2	3	4	5	6	7	8	9
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inch*	*Inch*
1/4 ..... 0.2500	7/16 ..... 0.4375	0.428	0.488	9/32	0.288	0.274	5/64	3/32
5/16 ..... .3125	1/2 ..... .5000	.489	.557	21/64	.336	.320	3/32	3/32
3/8 ..... .3750	9/16 ..... .5625	.551	.628	13/32	.415	.398	1/8	1/8
7/16 ..... .4375	5/8 ..... .6250	.612	.698	29/64	.463	.444	1/8	5/32
1/2 ..... .5000	3/4 ..... .7500	.736	.840	9/16	.573	.552	5/32	5/32
9/16 ..... .5625	7/8 ..... .8750	.861	.982	39/64	.621	.598	5/32	3/16
5/8 ..... .6250	15/16 ..... .9375	.922	1.051	23/32	.731	.706	3/16	7/32
3/4 ..... .7500	1 1/16 ..... 1.0625	1.045	1.191	13/16	.827	.798	3/16	1/4
7/8 ..... .8750	1 1/4 ..... 1.2500	1.231	1.403	29/32	.922	.890	3/16	1/4
1 ..... 1.0000	1 7/16 ..... 1.4375	1.417	1.615	1	1.018	.982	1/4	9/32
1 1/8 ..... 1.1250	1 5/8 ..... 1.6250	1.602	1.826	1 5/32	1.176	1.136	1/4	11/32
1 1/4 ..... 1.2500	1 13/16 ..... 1.8125	1.788	2.038	1 1/4	1.272	1.228	5/16	3/8
1 3/8 ..... 1.3750	2 ..... 2.0000	1.973	2.249	1 3/8	1.399	1.351	5/16	3/8
1 1/2 ..... 1.5000	2 3/16 ..... 2.1875	2.159	2.461	1 1/2	1.526	1.474	3/8	7/16

TABLE 118.—*Dimensions of semifinished hexagon light castle nuts*



Nominal size or basic major diameter of thread	Width across flats		Width across corners	Thickness			Height of flats[1]	Slot		Radius of fillet[2]	Diameter of cylindrical part,[3] Min
	Maximum (basic)	Min	Min	Nominal	Max	Min		Width	Depth		
1	2	3	4	5	6	7	8	9	10	11	12
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inch*	*Inch*	*Inch*	*Inches*
1/4 0.2500	7/16 0.4375	0.428	0.488	9/32	0.288	0.274	3/16	5/64	3/32	3/32	0.371
5/16 .3125	1/2 .5000	.489	.557	21/64	.336	.320	15/64	5/32	3/32	3/32	.425
3/8 .3750	9/16 .5625	.551	.628	13/32	.415	.398	9/32	1/8	1/8	3/32	.478
7/16 .4375	5/8 .6250	.612	.698	29/64	.463	.444	19/64	1/8	5/32	3/32	.531
1/2 .5000	3/4 .7500	.736	.840	9/16	.573	.552	15/32	5/32	5/32	1/8	.637
9/16 .5625	7/8 .8750	.861	.982	39/64	.621	.598	27/64	5/32	3/16	5/32	.744
5/8 .6250	15/16 .9375	.922	1.051	23/32	.731	.706	1/2	3/16	7/32	5/32	.797
3/4 .7500	1 1/16 1.0625	1.045	1.191	13/16	.827	.798	9/16	3/16	1/4	5/16	.903
7/8 .8750	1 1/4 1.2500	1.231	1.403	29/32	.922	.890	21/32	3/16	1/4	3/16	1.063
1 1.0000	1 7/16 1.4375	1.417	1.615	1	1.018	.982	23/32	1/4	9/32	3/16	1.222
1 1/8 1.1250	1 5/8 1.6250	1.602	1.826	1 5/32	1.176	1.136	13/16	1/4	11/32	1/4	1.382
1 1/4 1.2500	1 13/16 1.8125	1.788	2.038	1 1/4	1.272	1.228	7/8	5/16	3/8	1/4	1.541
1 3/8 1.3750	2 2.0000	1.973	2.249	1 3/8	1.399	1.351	1	5/16	3/8	1/4	1.700
1 1/2 1.5000	2 3/16 2.1875	2.159	2.461	1 1/2	1.526	1.474	1 1/16	3/8	7/16	1/4	1.859

[1] Height of the hexagon is measured from the bearing surface to top of arc.
[2] Tolerance on the fillet radius is ±0.010.
[3] Maximum diameter of cylindrical part shall not exceed maximum width across flats.

6. WRENCH OPENINGS

Dimensions of open end wrench openings for regular, heavy, and light series bolts and nuts shall conform to table 119.

Wrenches shall be marked with the nominal size of wrench, which is equal to the basic or maximum width across flats of the corresponding bolt head or nut.

TABLE 119.—*Open end wrench openings for regular, heavy, and light series bolts and nuts*

Nominal size of wrench, also basic or maximum width across flats, bolt heads and nuts	Allowance between bolt head or nut and jaws of wrench	Wrench openings			Nominal size of wrench, also basic or maximum width across flats, bolt heads and nuts	Allowance between bolt head or nut and jaws of wrench	Wrench openings		
		Min	Tolerance	Max			Min	Tolerance	Max
1	2	3	4	5	1	2	3	4	5
Inches	*Inch*	*Inches*	*Inch*	*Inches*	*Inches*	*Inch*	*Inches*	*Inch*	*Inches*
5/32.....0.1562	.002	0.158	0.005	0.163	1 13/16.....1.8125	0.010	1.822	0.013	1.835
3/16..... .1875	.002	.190	.005	.195	1 7/8.....1.8750	.010	1.885	.013	1.898
1/4..... .2500	.002	.252	.005	.257	2.....2.0000	.011	2.011	.014	2.025
5/16..... .3125	.003	.316	.006	.322	2 1/16.....2.0625	.011	2.074	.014	2.088
11/32..... .3438	.003	.347	.006	.353	2 3/16.....2.1875	.012	2.200	.015	2.215
3/8..... .3750	.003	.378	.006	.384	2 1/4.....2.2500	.012	2.262	.015	2.277
7/16..... .4375	.003	.440	.006	.446	2 5/8.....2.3750	.013	2.388	.016	2.404
1/2..... .5000	.004	.504	.006	.510	2 7/16.....2.4375	.013	2.450	.016	2.466
9/16..... .5625	.004	.566	.007	.573	2 9/16.....2.5625	.014	2.576	.017	2.593
19/32..... .5938	.004	.598	.007	.605	2 5/8.....2.6250	.014	2.639	.017	2.656
5/8..... .6250	.004	.629	.007	.636	2 3/4.....2.7500	.015	2.765	.018	2.783
11/16..... .6875	.004	.692	.007	.699	2 13/16.....2.8125	.015	2.827	.018	2.845
3/4..... .7500	.005	.755	.008	.763	2 15/16.....2.9375	.016	2.954	.019	2.973
25/32..... .7812	.005	.786	.008	.794	3.....3.0000	.016	3.016	.019	3.035
13/16..... .8125	.005	.818	.008	.826	3 1/8.....3.1250	.017	3.142	.020	3.162
7/8..... .8750	.005	.880	.008	.888	3 3/8.....3.3750	.018	3.393	.021	3.414
15/16..... .9375	.006	.944	.009	.953	3 1/2.....3.5000	.018	3.518	.022	3.540
1.....1.0000	.006	1.006	.009	1.015	3 3/4.....3.7500	.020	3.770	.023	3.793
1 1/16.....1.0625	.006	1.068	.009	1.077	3 7/8.....3.8750	.020	3.895	.023	3.918
1 1/8.....1.1250	.007	1.132	.010	1.142	4 1/8.....4.1250	.022	4.147	.025	4.172
1 1/4.....1.2500	.007	1.257	.010	1.267	4 1/4.....4.2500	.022	4.272	.025	4.297
1 5/16.....1.3125	.008	1.320	.011	1.331	4 1/2.....4.5000	.024	4.524	.026	4.550
1 3/8.....1.3750	.008	1.383	.011	1.394	4 5/8.....4.6250	.024	4.649	.027	4.676
1 7/16.....1.4375	.008	1.446	.011	1.457	5.....5.0000	.026	5.026	.029	5.055
1 1/2.....1.5000	.008	1.508	.012	1.520	5 3/8.....5.3750	.028	5.403	.031	5.434
1 5/8.....1.6250	.009	1.634	.012	1.646	5 3/4.....5.7500	.030	5.780	.033	5.813
1 11/16.....1.6875	.009	1.696	.012	1.708	6 1/8.....6.1250	.032	6.157	.035	6.192

SECTION XII. ROUND UNSLOTTED HEAD BOLTS[29]

These standards for round unslotted head bolts are intended for general use, and to replace such other series of dimensions as have been used. They constitute a single series of bolt heads of various types.

1. RECOMMENDED REQUIREMENTS

(*a*) WORKMANSHIP.—The workmanship shall be compatible with the type of product and class of fit and finish specified. The product shall be free from abnormal scale, fins, seams, or other defects. All bolts shall be free from any defects which might affect their serviceability.

(*b*) THREAD SERIES.—Unless otherwise specified the number of threads per inch shall be that specified for the American National coarse-thread series. These bolts may be supplied with either rolled or cut threads. Rolled thread bolts are not pointed.

(*c*) DETAILS OF DESIGN.—1. *Length of bolts.*—Bolt length, *L*, is measured from the greatest diameter of the bearing surface of (or under) the head, to the end of the bolt, in a line parallel to the axis of the bolt.

Tolerances for bolt lengths 6 in. and under are ± 1/32 in. for diameters 1/4 to 3/8 in., inclusive; ± 1/16 in. for diameters 7/16

[29] This standard is in agreement with that adopted by the American Standards Association, and published as ASA B18.5-1939 "Round Unslotted Head Bolts," by the ASME, 29 West 39th St., New York 18, N. Y. (50c).

and ½ in.; ± ⅛ in. for diameters ⅝ to 1¼ in., inclusive; and ±¼ in. for diameters 1⅜ to 2 in., inclusive.

Tolerances for bolt lengths over 6 in. are ± 1/16 in. for diameters ¼ to ⅜ in., inclusive; ± 3/32 in. for diameters 7/16 and ½ in.; ± 3/16 in. for diameters ⅝ to 1¼ in., inclusive; and ± ¼ in. for diameters 1⅜ to 2 in., inclusive.

2. *Length of threads.*—The minimum length of thread, *T*, of all types of round unslotted head bolts shall, unless otherwise specified, conform to table 102, p. 183. The minimum thread length is measured from the extreme end of the bolt to the last complete thread. The length of incomplete thread shall not exceed 2½ threads.

For bolts too short for the specified minimum thread lengths, threads shall be cut or rolled to within ¼ in. of head or neck on sizes up to and including ½ in.; ⅜ in. on sizes 9/16 to 1 in., inclusive; and ½ in. on sizes 1⅛ to 2 in., inclusive.

3. *Tolerances on body diameter.*—Tolerances on body diameter are not specified. See p. 181.

4. *Fillet under heads.*—The maximum radius, *S*, under the head of bolts for sizes No. 10 (0.190 in.) to ½ in., inclusive, shall be 1/32 in., and for sizes 9/16 to 1 in., inclusive, shall be 1/16 in.

2. TABLES OF DIMENSIONS

(*a*) Square-Neck Carriage Bolts.—The dimensions of square-neck carriage bolts shall conform to table 120.

(*b*) Ribbed-Neck Carriage Bolts.—The dimensions of ribbed-neck carriage bolts shall conform to table 121. The included angle of the ribs shall be approximately 90°.

(*c*) Fin-Neck Carriage Bolts.—The dimensions of fin-neck carriage bolts shall conform to table 122.

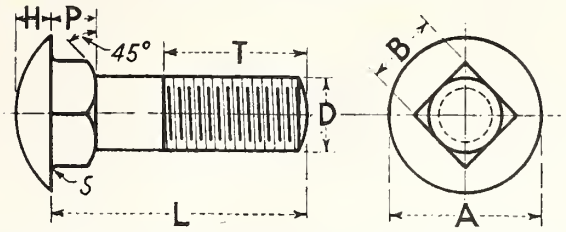
(*d*) Countersunk Carriage Bolts.—The dimensions of countersunk carriage bolts shall conform to table 123. The tolerance for the included angle of head is plus 2°.

(*e*) Buttonhead Bolts.—The dimensions of buttonhead bolts shall conform to table 124.

(*f*) Step Bolts.—The dimensions of step bolts shall conform to table 125.

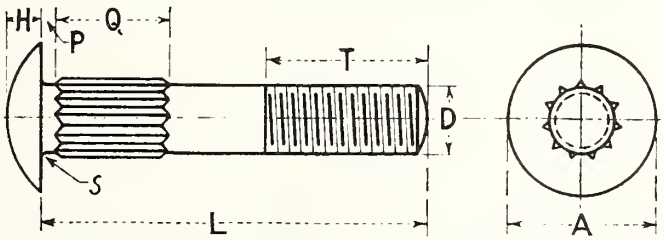
(*g*) Countersunk Bolts.—The dimensions of countersunk bolts shall conform to table 126. The depth of head, *H*, is given for construction purposes only. Variations in this dimension are controlled by the diameters *A* and *D*, and by the included angle of the head. The tolerance for included angle of head is plus 2°. For sizes smaller than ½ in. see section XIII.

TABLE 120.—*Dimensions of square-neck carriage bolts*



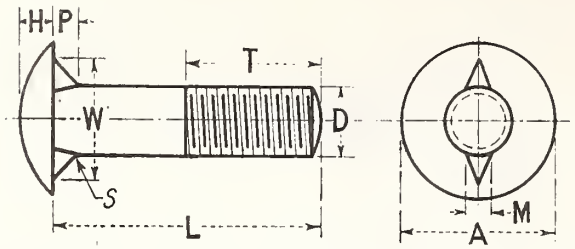
Nominal diameter of bolt, *D*	Diameter of head, *A*		Height of head, *H*		Depth of square, *P*			Width of square, *B*	
	Minimum	Max	Minimum	Max	For bolt lengths	Min	Max	Min	Max
1	2	3	4	5	6	7	8	9	10
Inch	*Inches*	*Inches*	*Inch*	*Inch*	*Inches*	*Inch*	*Inch*	*Inch*	*Inches*
No. 10 (0.190)	7/16 ..... 0.438	0.469	3/32 ..... 0.094	0.114	1 1/8 and shorter...	0.094	0.125	0.185	0.199
					1 1/4 and longer....	.188	.219		
1/4	9/16 ..... .563	.594	1/8 ..... .125	.145	1 1/4 and shorter...	.125	.156	.245	.260
					1 3/8 and longer....	.219	.250		
5/16	11/16 ..... .688	.719	5/32 ..... .156	.176	1 1/4 and shorter...	.156	.187	.307	.324
					1 3/8 and longer....	.250	.281		
3/8	13/16 ..... .813	.844	3/16 ..... .188	.208	1 1/2 and shorter...	.188	.219	.368	.388
					1 5/8 and longer....	.281	.312		
7/16	15/16 ..... .938	.969	7/32 ..... .219	.239	1 1/2 and shorter...	.219	.250	.431	.452
					1 5/8 and longer....	.313	.344		
1/2	1 1/16 ..... 1.063	1.094	1/4 ..... .250	.270	1 7/8 and shorter...	.250	.281	.492	.515
					2 and longer.....	.344	.375		
9/16	1 3/16 ..... 1.188	1.219	9/32 ..... .281	.312	1 7/8 and shorter...	.281	.312	.554	.579
					2 and longer.....	.375	.406		
5/8	1 5/16 ..... 1.313	1.344	5/16 ..... .313	.344	1 7/8 and shorter...	.313	.344	.616	.642
					2 and longer.....	.406	.437		
3/4	1 9/16 ..... 1.563	1.594	3/8 ..... .375	.406	1 7/8 and shorter...	.375	.406	.741	.768
					2 and longer.....	.469	.500		
7/8	1 13/16 ..... 1.813	1.844	7/16 ..... .438	.469	1 7/8 and shorter...	.438	.469	.865	.895
					2 and longer.....	.531	.562		
1	2 1/16 ..... 2.063	2.094	1/2 ..... .500	.531	1 7/8 and shorter...	.500	.531	.990	1.022
					2 and longer.....	.594	.625		

TABLE 121.—*Dimensions of ribbed-neck carriage bolts*



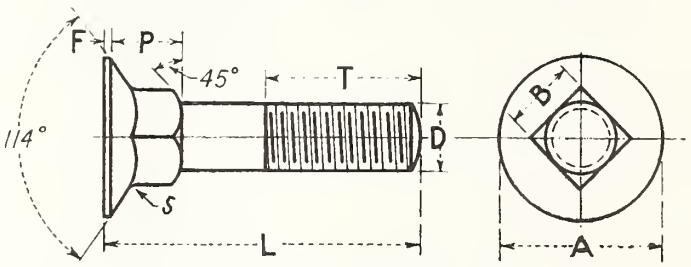
Nominal diameter of bolt, *D*	Diameter of head, *A*		Height of head, *H*		Distance of ribs below head, *P*			Length of ribs, *Q*			No. of ribs
	Minimum	Maximum	Minimum	Max	For *L* = 7/8 or less	For *L* = 1 or more	Tol.	For *L* = 7/8 or less	For *L* = 1 and 1 1/8	For *L* = 1 1/4 or more	
1	2	3	4	5	6	7	8	9	10	11	12
Inch	*Inches*	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch* ±	*Inch*	*Inch*	*Inch*	
No. 10 (0.190)	7/16 ..... 0.438	0.469	3/32 ..... 0.094	0.114	0.031	0.063	0.031	0.188	0.313	0.500	9
1/4	9/16 ..... .563	.594	1/8 ..... .125	.145	.031	.063	.031	.188	.313	.500	10
5/16	11/16 ..... .688	.719	5/32 ..... .156	.176	.031	.063	.031	.188	.313	.500	12
3/8	13/16 ..... .813	.841	3/16 ..... .188	.208	.031	.063	.031	.188	.313	.500	12
7/16	15/16 ..... .938	.969	7/32 ..... .219	.239	.031	.063	.031	.188	.313	.500	14
1/2	1 1/16 ..... 1.063	1.094	1/4 ..... .250	.270	.031	.063	.031	.188	.313	.500	16
9/16	1 3/16 ..... 1.188	1.219	9/32 ..... .281	.312	.094	.094	.031	.188	.313	.500	18
5/8	1 5/16 ..... 1.313	1.344	5/16 ..... .313	.344	.094	.094	.031	.188	.313	.500	19
3/4	1 9/16 ..... 1.563	1.594	3/8 ..... .375	.406	.094	.094	.031	.188	.313	.500	22

TABLE 122.—*Dimensions of fin-neck carriage bolts*



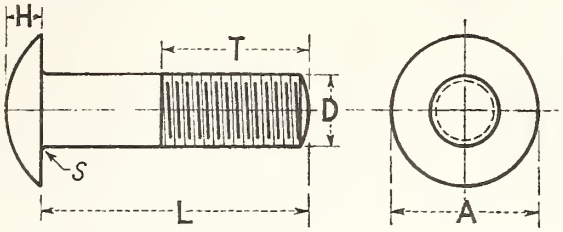
Nominal diameter of bolt, *D*	Diameter of head, *A*		Height of head, *H*		Depth of fins, *P*		Distance across fins, *W*		Thickness of fins, *M*	
	Minimum	Max	Minimum	Max	Minimum	Max	Minimum	Max	Minimum	Max
1	2	3	4	5	6	7	8	9	10	11
Inch	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
No. 10 (0.190)	15/32...0.469	0.489	5/64....0.078	0.098	5/64....0.078	0.088	3/8.....0.375	0.395	5/64....0.078	0.098
1/4	19/32... .594	.614	7/64.... .109	.129	3/32.... .094	.104	7/16.... .438	.458	3/32.... .094	.114
5/16	23/32... .719	.739	9/64.... .141	.161	1/8..... .125	.135	17/32... .531	.551	1/8..... .125	.145
3/8	27/32... .844	.864	11/64... .172	.192	9/64.... .141	.151	5/8..... .625	.645	9/64.... .141	.161
7/16	31/32... .969	.989	13/64... .203	.223	11/64... .172	.182	23/32... .719	.739	11/64... .172	.192
1/2	1 3/32...1.094	1.114	15/64... .234	.254	3/16.... .188	.198	13/16... .813	.833	3/16.... .188	.208

TABLE 123.—*Dimensions of countersunk carriage bolts*



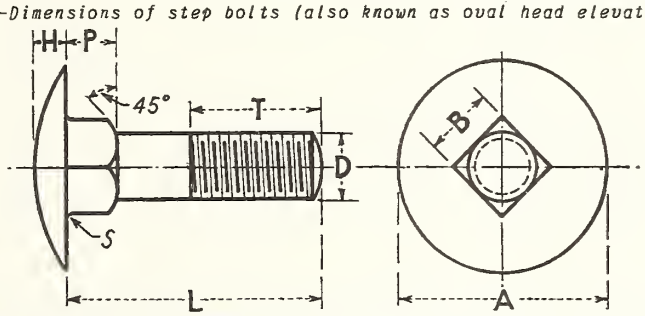
Nominal diameter of bolt, *D*	Diameter of head, *A*		Feed thickness, *F*	Depth of square and countersink, *P*		Width of square, *B*	
	Minimum	Maximum		Minimum	Maximum	Minimum	Maximum
1	2	3	4	5	6	7	8
Inch	*Inches*	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
No. 10 (0.190)	1/2.....0.500	0.520	0.016	7/32.....0.219	0.250	0.185	0.199
1/4	5/8..... .625	.645	.016	9/32..... .281	.312	.245	.260
5/16	3/4..... .750	.770	.031	11/32..... .344	.375	.307	.324
3/8	7/8..... .875	.895	.031	13/32..... .406	.437	.368	.388
7/16	1.....1.000	1.020	.031	15/32..... .469	.500	.431	.452
1/2	1 1/8.....1.125	1.145	.031	17/32..... .531	.562	.492	.515
9/16	1 1/4.....1.250	1.275	.031	19/32..... .594	.625	.554	.579
5/8	1 3/8.....1.375	1.400	.031	21/32..... .656	.687	.616	.642
3/4	1 5/8.....1.625	1.650	.047	25/32..... .781	.812	.741	.768

TABLE 124.—*Dimensions of buttonhead bolts*



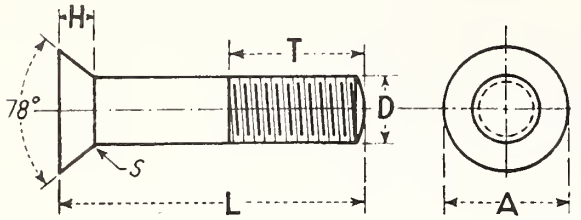
Nominal diameter of bolt, *D*	Diameter of head, *A*		Height of head, *H*	
	Minimum	Maximum	Minimum	Maximum
1	2	3	4	5
Inch	*Inches*	*Inches*	*Inch*	*Inch*
No. 10 (0.190)	7/16 0.438	0.469	3/32 0.094	0.114
1/4	9/16 .563	.594	1/8 .125	.145
5/16	11/16 .688	.719	5/32 .156	.176
3/8	13/16 .813	.844	3/16 .188	.208
7/16	15/16 .938	.969	7/32 .219	.239
1/2	1 1/16 1.063	1.094	1/4 .250	.270
9/16	1 3/16 1.188	1.219	9/32 .281	.312
5/8	1 5/16 1.313	1.344	5/16 .313	.344
3/4	1 9/16 1.563	1.594	3/8 .375	.406
7/8	1 13/16 1.813	1.844	7/16 .438	.469
1	2 1/16 2.063	2.094	1/2 .500	.531

TABLE 125.—*Dimensions of step bolts (also known as oval head elevator bolts)*



Nominal diameter of bolt, *D*	Diameter of head, *A*		Height of head, *H*		Depth of square, *P*			Width of square, *B*	
	Minimum	Maximum	Minimum	Maximum	For bolt lengths	Minimum	Maximum	Minimum	Maximum
1	2	3	4	5	6	7	8	9	10
Inch	*Inches*	*Inches*	*Inch*	*Inch*	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*
No. 10 (0.190)	0.625	0.656	0.094	0.114	1 1/8 and shorter	0.094	0.125	0.185	0.199
					1 1/4 and longer	.188	.219		
1/4	.813	.844	.125	.145	1 1/4 and shorter	.125	.156	.245	.260
					1 3/8 and longer	.219	.250		
5/16	1.000	1.031	.156	.176	1 1/4 and shorter	.156	.187	.307	.324
					1 3/8 and longer	.250	.281		
3/8	1.188	1.219	.188	.208	1 1/2 and shorter	.188	.219	.368	.388
					1 5/8 and longer	.281	.312		
7/16	1.375	1.406	.219	.239	1 1/2 and shorter	.219	.250	.431	.452
					1 5/8 and longer	.313	.344		
1/2	1.563	1.594	.250	.270	1 7/8 and shorter	.250	.281	.492	.515
					2 and longer	.344	.375		

TABLE 126.—*Dimensions of countersunk bolts*



Nominal diameter of bolt, *D*	Diameter of head, *A*			Depth of head, *H*
	Basic	Maximum	Minimum	
1	2	3	4	5
Inches	*Inches*	*Inches*	*Inches*	*Inch*
½	0.905	0.936	0.874	0.250
9/16	1.018	1.049	.987	.281
5/8	1.131	1.194	1.068	.313
3/4	1.358	1.421	1.295	.375
7/8	1.584	1.647	1.521	.438
1	1.810	1.873	1.747	.500
1⅛	2.036	2.114	1.973	.563
1¼	2.263	2.341	2.200	.625
1⅜	2.489	2.567	2.426	.688
1½	2.715	2.793	2.652	.750
1⅝	2.941	3.019	2.878	.813
1¾	3.168	3.262	3.105	.875
1⅞	3.394	3.488	3.425	.938
2	3.620	3.714	3.651	1.000

SECTION XIII. MACHINE SCREWS, MACHINE-SCREW AND STOVE-BOLT NUTS, AND SET SCREWS

These standards for machine screws, machine-screw and stove-bolt nuts, and square-head and slotted set screws are intended for general use and to replace such other series of dimensions as have been used. These standards for machine screws are in agreement with the Bureau of Ships ad interim specification 42S5 (INT), August 1, 1943, and with standards of the American Standards Association, as noted in footnotes to the tables. They constitute a single series of screw heads, with the exception of square-head set screws for which an optional design is presented, and a single series of nuts. For nuts of larger sizes see section XI.

1. RECOMMENDED REQUIREMENTS, MACHINE SCREWS AND SET SCREWS

(*a*) WORKMANSHIP.—The workmanship shall be compatible with the type of product and class of fit specified. The product shall be free from fins, seams, or other defects, which may affect their serviceability.

Unless the method of manufacture is specifically stated the method of manufacture employed for the production of screw threads on machine screws and set screws shall be by chasing, milling, die cutting, or rolling.

(*b*) THREAD SERIES AND CLASSES OF FIT.—The number of threads per inch shall be that specified for the American National coarse-thread series or the American National fine-thread series. Unless otherwise specified, machine screws shall be of the coarse-thread series, class 2 fit; set screws ¼ inch and under shall be of the fine thread series, class 2 fit; and set screws over ¼ inch shall be coarse thread series, class 3 fit.

(*c*) DETAILS OF DESIGN.—1. *Length of screws.*—The length of machine screws is measured from the largest diameter of the bearing surface of the head to the extreme point, in a line parallel with the axis of the screw. Preferred lengths of machine screws are listed in table 127. The length of headless set screws is the over-all length. The length of square-head set screws is measured from the bottom of the square head to the extreme point, in a line parallel to the axis of the screw. The length of machine screws shall not vary from that specified by more than the following: Up to 1 inch in length, +1/64, −1/32 in.; over 1 to 2 inches, inclusive, +1/32, −1/16 in.; and over 2 inches, +3/64, −3/32 in.

2. *Length of threads.*—The length of threaded portion of flat, round, and fillister head screws ⅜ inch in diameter and smaller, and of oval head screws of all diameters, of lengths up to and including 2 inches, shall extend to within 2 threads from the bearing surface of the head.

Longer screws shall have a minimum complete thread length of $1\frac{3}{4}$ inches. The minimum length of threaded portion of flat, round, and fillister head screws $\frac{7}{16}$ inch in diameter and larger shall be equal to twice the diameter plus $\frac{1}{4}$ inch. The minimum thread length shall be measured from the extreme end of the screw to the last complete thread. Screws too short to permit threading as above shall be threaded as close to the head as practicable.

Set screws shall be threaded the entire length of the cylindrical portion.

3. *Body diameter.*—The diameters of the unthreaded portions shall conform to the respective diameters given in tables 128 to 132, inclusive.

4. *Bearing surface.*—The bearing surface of round and fillister head machine screws shall be at right angles to the axis of the body of the screw within a tolerance of 2°. The heads of all machine screws shall be concentric with the axis of the body within a tolerance of 3 percent of the maximum head diameter.

2. TABLES OF DIMENSIONS, MACHINE SCREWS AND SET SCREWS

(*a*) MACHINE SCREWS.—Dimensions of flat-head, round-head, oval-head, oval-fillister-head, and flat-fillister-head machine screws shall conform to tables 128, 129, 130, 131, and 132, respectively.

(*b*) SQUARE-HEAD SET SCREWS.—Dimensions of square set screws shall conform to tables 133 or 134. Details of screws conforming to table 133 shall be as follows: Length of neck under head shall not be over twice the pitch of the thread. The under surface of the head shall be beveled not more than 40°. Top or crown of head shall be rounded to a radius of two and a half times the major diameter of the thread. The points of set screws shall be concentric with the threads.

(*c*) SLOTTED OR SOCKET SET SCREWS.—Dimensions of slotted or socket set screws shall conform to table 134. The points of set screws shall be concentric with the threads.

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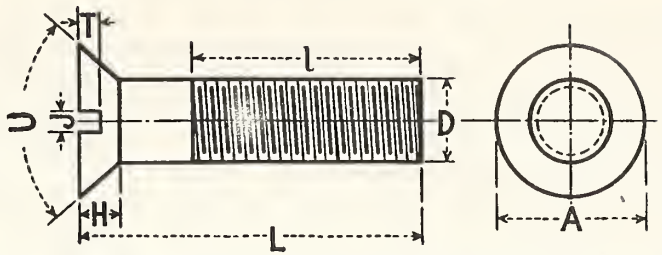
TABLE 127.—*Preferred screw lengths for various styles of heads, machine screws*

Length, (*L*)	Steel screws, machine screw number or nominal size																Brass screws, machine screw number or nominal size												
	American National coarse-thread series												American National fine-thread series				American National coarse-thread series												American National fine-thread series
	2	3	4	5	6	8	10	12	¼	5/16	3/8	½	6	8	10	¼	2	3	4	5	6	8	10	12	¼	5/16	3/8	½	10
	Threads per inch																												
	56	48	40	40	32	32	24	24	20	18	16	13	40	36	32	28	56	48	40	40	32	32	24	24	20	18	16	13	32
Inches																													
1/8	*RP*	*RP*	*RP*	*RP*	*RP*	....	....	....	....	....	....	....	...	...	....	...	*RP*	*RP*	*R*	*R*	*R*	....	....	...	....	....	...	...	.....
3/16	FRP	FRP	*FRP*	*FRP*	*FRP*	*RP*	*R*	....	....	....	....	....	*R*	...	*R*	...	FRP	FRP	*FRP*	*FRP*	*FRP*	*RP*	....	...	....	....	...	...	*R*
1/4	FRP	FRP	FROP	FRP	FROP	*FROP*	*FRP*	*R*	*R*	....	....	....	R	*FR*	*FRP*	...	FRP	FRP	FROP	FRP	FROP	*FROP*	*FRP*	*R*	....	....	...	...	*FRP*
5/16	FRP	FRP	FROP	FRP	FROP	FROP	*FROP*	*RP*	*RP*	....	....	....	R	FR	*FROP*	*R*	FRP	FR	FRO	FR	FROP	FROP	*FRP*	...	*R*	....	...	...	*FRP*
3/8	FRP	FRP	FROP	FRP	FROP	FROP	FROP	*FROP*	*FRP*	*R*	....	....	FR	FR	FROP	*FR*	FRP	FR	FROP	FRP	FROP	FROP	FROP	*FR*	*FR*	*R*	...	...	FROP
7/16	R	R	FROP	RP	FROP	FROP	FROP	FR	*FRP*	....	....	....	...	...	FROP	*F*	R	R	FR	R	FRO	FRO	R	...	*R*	....	...	...	FR
1/2	FRP	FRP	FROP	FRP	FROP	FROP	FROP	FROP	FROP	*FROP*	*FR*	....	FR	FR	FROP	FR	FRP	FR	FROP	FRP	FROP	FROP	FROP	FR	FROP	*FR*	*FR*	...	FROP
9/16	....	....	R	....	R	R	R	....	R	....	....	....	...	...	R	...	...	...	....	...	R	R	R	...	....	....	...	...	.....
5/8	FR	FR	FROP	FRP	FROP	FROP	FROP	FROP	FROP	FROP	FR	....	FR	FR	FROP	FR	FR	FR	FR	R	FROP	FROP	FROP	FR	FROP	FR	FR	...	FROP
3/4	R	R	FRP	FRP	FROP	FROP	FROP	FROP	FROP	FROP	FRP	*F*	FR	FR	FROP	FR	R	R	FR	FR	FROP	FROP	FROP	FR	FROP	FRP	FR	*F*	FROP
7/8	....	....	FR	RP	FROP	FROP	FROP	FRP	FROP	FRP	FR	....	...	...	FROP	F	...	...	R	...	FR	FR	FR	R	FR	R	F	...	FR
1	....	....	FR	FRP	FROP	FROP	FROP	FROP	FROP	FROP	FRP	FR	FR	FR	FROP	FR	...	...	FR	FR	FROP	FROP	FROP	FR	FROP	FRP	FR	FR	FROP
1 1/8	....	....	....	....	R	FR	FR	R	FR	R	R	....	...	...	FR	...	...	...	....	...	R	R	R	...	....	....	...	...	R
1 1/4	....	....	R	R	FROP	FROP	FROP	FROP	FROP	FRP	FRP	FR	R	R	FROP	FR	...	...	R	R	FRO	FROP	FROP	FR	FROP	FRP	FR	FR	FROP
1 1/2	....	....	R	R	FRP	FROP	FROP	FRP	FROP	FRP	FRP	FR	...	...	FROP	FR	...	...	....	...	FR	FROP	FROP	FR	FROP	FRP	FR	FR	FROP
1 3/4	....	....	....	....	FRP	FRP	FRP	RP	FRP	FRP	FRP	F	...	...	FRP	...	...	...	....	...	R	FR	FR	...	FR	R	...	...	FR
2	....	....	....	R	FRP	FRP	FRP	FRP	FRP	FRP	FRP	FR	...	...	FRP	R	...	...	....	...	FR	FR	FR	FR	FR	FR	FR	FR	FR
2 1/4	....	....	....	....	....	R	FR	....	FR	FR	F	....	...	...	R	...	...	...	....	...	....	R	R	...	R	....	...	...	R
2 1/2	....	....	....	....	....	FR	FR	....	FRP	FRP	FRP	FR	...	...	FR	...	...	...	....	...	....	R	R	...	FR	FR	FR	...	R
2 3/4	....	....	....	....	....	R	R	....	FR	FR	....	....	...	...	R	...	...	...	....	...	....	....	....	...	....	....	...	...	.....
3	....	....	....	....	....	FR	FR	....	FR	FR	FR	FR	...	...	FR	...	...	...	....	...	....	R	R	...	FR	FR	FR	...	R

NOTE.—This table of screw lengths is intended only as a guide to the users of these screws. Diameters, pitches, and lengths not regularly stocked by the manufacturers will be available on order of a sufficient quantity. Letters in the vertical column under the nominal screw sizes indicate the style of head for a particular length of screw thus: F = flat head, R = round head, *O* = oval head, *P* = fillister head. Short-length flat and oval head screws indicated in italics have undercut heads, with the countersunk portion approximately two-thirds of the standard height, with slot depths proportionately less, but with standard head diameters.

This table was developed and adopted by the Screw Industry Standards Committee, October 15, 1941. It is subject to revision to bring it into agreement with revision of ASA B18c, now in preparation.

TABLE 128.—*Dimensions of flat-head machine screws*



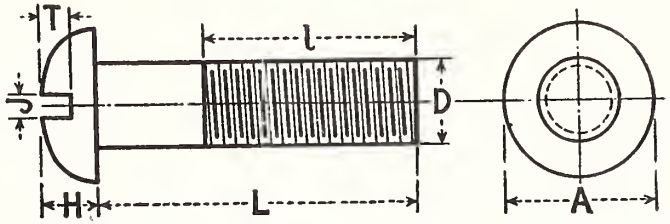
[Countersink angle: Maximum $U = 82°$; minimum $U = 80°$]

Nominal size	American National coarse-thread series, class 2 fit			American National fine-thread series, class 2 fit			Dimensions of head							
							D	*A*		*H*	*J*		*T*	
	Threads per inch	Body diameter		Threads per inch	Body diameter		Nominal diameter of wire	Diameter of head		Height of head	Width of slot		Depth of slot	
		Maximum	Minimum		Maximum	Minimum		Maximum	Minimum	Nominal	Maximum	Minimum	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Inch	*Inch*		*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
0	.....	.....	.....	80	0.0600	[3]	.....	0.119	0.097	0.030	0.022	0.016	0.015	0.009
1	64	0.0730	[3]	72	.0730	[3]	.....	.146	.122	.038	.025	.019	.019	.012
2	56	.0860	[3]	64	.0860	[3]	0.086	.172	.156	.046	.036	.024	.023	.015
3	48	.0990	[3]	56	.0990	[3]	.099	.199	.181	.053	.038	.026	.027	.017
4	40	.1120	[3]	48	.1120	[3]	.112	.225	.207	.061	.040	.028	.030	.020
5	[1]40	.1250	[3]	44	.1250	[3]	.125	.252	.232	.069	.043	.031	.034	.022
6	32	.1380	[3]	40	.1380	[3]	.138	.279	.257	.076	.045	.033	.038	.024
8	[1]32	.1640	[3]	36	.1640	[3]	.164	.332	.308	.092	.050	.037	.045	.029
10	[1]24	.1900	[3]	32	.1900	[3]	.190	.385	.359	.107	.055	.041	.053	.034
12	[1]24	.2160	[3]	28	.2160	[3]	.216	.438	.410	.122	.059	.045	.060	.039
1/4	[1]20	.2500	[3]	28	.2500	[3]	.250	.507	.477	.142	.066	.051	.070	.046
5/16	[1]18	.3125	[3]	24	.3125	[3]	.3125	.636	.600	.179	.077	.061	.088	.058
3/8	[1]16	.3750	[3]	24	.3750	[3]	.3750	.762	.722	.215	.088	.072	.106	.070
7/16[2]	14	.4375	0.4277	20	.4375	0.4303	.4375	.813	.780	.220	.098	.083	.110	.075
1/2[2]	13	.5000	.4896	20	.5000	.4928	.5000	.875	.841	.220	.110	.094	.110	.080
9/16[2]	12	.5625	.5513	18	.5625	.5543	.5625	1.000	.962	.256	.123	.106	.128	.083
5/8[2]	11	.6250	.6132	18	.6250	.6168	.6250	1.125	1.083	.293	.138	.119	.146	.096
3/4[2]	10	.7500	.7372	16	.7500	.7410	.7500	1.375	1.326	.366	.154	.134	.183	.123

[1] These sizes in the coarse-thread series are interchangable with stove-bolt sizes. See table 135 p. 211.
[2] Sizes 7/16 inch and over are in agreement with ASA standards for cap screws, ASA B18c-1930.
[3] The minimum diameter of the unthreaded body is the same as the pitch diameter of the screw thread.

NOTE.—Dimensions in this table are subject to revision to bring them into agreement with revision of ASA B18c, now in preparation.

TABLE 129.—*Dimensions of round-head machine screws*

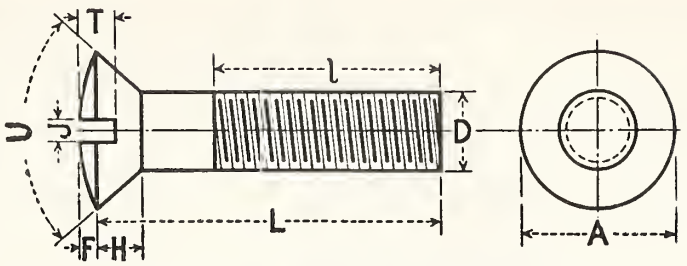


Nominal size	American National coarse-thread series, class 2 fit			American National fine-thread series, class 2 fit			Dimensions of head								
							D	*A*		*H*		*J*		*T*	
	Threads per inch	Body diameter		Threads per inch	Body diameter		Nominal diameter of wire	Diameter of head		Height of head		Width of slot		Depth of slot	
		Maximum	Minimum		Maximum	Minimum		Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		Inch	*Inch*		*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
0	.....	.....	.....	80	0.0600	[3]	0.060	0.113	0.099	0.053	0.042	0.022	0.016	0.039	0.029
1	64	0.0730	[3]	72	.0730	[3]	.073	.138	.122	.061	.050	.025	.019	.043	.032
2	56	.0860	[3]	64	.0860	[3]	.086	.162	.146	.070	.059	.036	.024	.048	.036
3	48	.0990	[3]	56	.0990	[3]	.099	.187	.169	.078	.067	.038	.026	.053	.040
4	40	.1120	[3]	48	.1120	[3]	.112	.211	.193	.086	.075	.040	.028	.058	.043
5	[1]40	.1250	[3]	44	.1250	[3]	.125	.236	.217	.095	.083	.043	.031	.062	.047
6	32	.1380	[3]	40	.1380	[3]	.138	.260	.240	.103	.091	.045	.033	.067	.050
8	[1]32	.1640	[3]	36	.1640	[3]	.164	.309	.287	.119	.107	.050	.037	.076	.057
10	[1]24	.1900	[3]	32	.1900	[3]	.190	.359	.334	.136	.124	.055	.041	.086	.064
12	[1]24	.2160	[3]	28	.2160	[3]	.216	.408	.382	.152	.140	.059	.045	.095	.071
1/4	[1]20	.2500	[3]	28	.2500	[3]	.250	.472	.443	.174	.161	.066	.051	.108	.080
5/16	[1]18	.3125	[3]	24	.3125	[3]	.3125	.591	.557	.214	.200	.077	.061	.130	.097
3/8	[1]16	.3750	[3]	24	.3750	[3]	.3750	.708	.670	.254	.239	.088	.072	.153	.114
7/16 [2]	14	.4375	0.4277	20	.4375	0.4303	.4375	.750	.725	.328	.302	.098	.083	.202	.167
1/2 [2]	13	.5000	.4896	20	.5000	.4928	.5000	.813	.786	.355	.328	.110	.094	.219	.179
9/16 [2]	12	.5625	.5513	18	.5625	.5543	.5625	.938	.908	.410	.379	.123	.106	.253	.208
5/8 [2]	11	.6250	.6132	18	.6250	.6168	.6250	1.000	.970	.438	.405	.138	.119	.270	.220
3/4 [2]	10	.7500	.7372	16	.7500	.7410	.7500	1.250	1.215	.547	.506	.154	.134	.337	.277

[1] These sizes in the coarse-thread series are interchangeable with stove-bolt sizes. See table 135, p. 211.
[2] Sizes 7/16 inch and over are in agreement with ASA standards for cap screws, ASA B18c-1930.
[3] The minimum diameter of the unthreaded body is the same as the pitch diameter of the screw thread.

NOTE.—Dimensions in this table are subject to revision to bring them into agreement with revision of ASA B18c, now in preparation.

TABLE 130.—*Dimensions of oval-head machine screws*



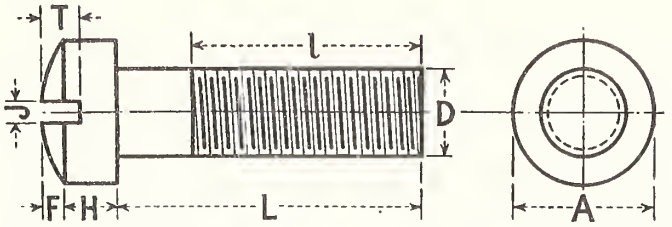
[Countersink angle: Maximum $U = 82^\circ$; minimum $U = 80^\circ$]

Nominal size	American National coarse-thread series, class 2 fit		American National fine-thread series, class 2 fit		Dimensions of head											
					D	*A*		*H*	*J*		*T*		*F*		*F* and *H*	
	Threads per inch	Body diameter,[1] maximum	Threads per inch	Body diameter,[1] maximum	Nominal diameter of wire	Diameter of head		Height of head, nominal	Width of slot		Depth of slot		Height of oval		Total height of head	
						Maximum	Minimum		Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		Inch		*Inch*	*Inch*	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
0	.....	.....	80	0.0600	0.060	0.119	0.101	0.030	0.022	0.016	0.030	0.025	0.021	0.015	0.056	0.041
1	64	0.0730	72	.0730	.073	.146	.125	.038	.025	.019	.038	.030	.025	.019	.068	.052
2	56	.0860	64	.0860	.086	.172	.156	.046	.036	.024	.045	.037	.029	.022	.080	.063
3	48	.0990	56	.0990	.099	.199	.181	.053	.038	.026	.052	.043	.033	.026	.092	.073
4	40	.1120	48	.1120	.112	.225	.207	.061	.040	.028	.059	.049	.037	.029	.104	.084
5	40	.1250	44	.1250	.125	.252	.232	.069	.043	.031	.067	.055	.041	.033	.116	.095
6	32	.1380	40	.1380	.138	.279	.257	.076	.045	.033	.074	.060	.045	.036	.128	.105
8	32	.1640	36	.1640	.164	.332	.308	.092	.050	.037	.088	.072	.053	.043	.152	.126
10	24	.1900	32	.1900	.190	.385	.359	.107	.055	.041	.103	.084	.061	.050	.176	.148
12	24	.2160	28	.2160	.216	.438	.410	.122	.059	.045	.117	.096	.069	.057	.200	.169
1/4	20	.2500	28	.2500	.250	.507	.477	.142	.066	.051	.136	.112	.079	.066	.232	.197
5/16	18	.3125	24	.3125	.3125	.636	.600	.179	.077	.061	.171	.141	.098	.083	.290	.249
3/8	16	.3750	24	.3750	.3750	.762	.722	.215	.088	.072	.206	.170	.117	.100	.347	.300
7/16	14	.4375	20	.4375	.4375	.813	.780	.220	.098	.083	.209	.175	.125	.111	.355	.308
1/2	13	.5000	20	.5000	.5000	.875	.841	.220	.110	.094	.214	.180	.135	.120	.365	.317

[1]The minimum diameter of the unthreaded body is the same as the pitch diameter of the screw thread.

NOTE.—Dimensions in this table are subject to revision to bring them into agreement with revision of ASA B18c, now in preparation.

TABLE 131.—*Dimensions of oval-fillister-head machine screws*

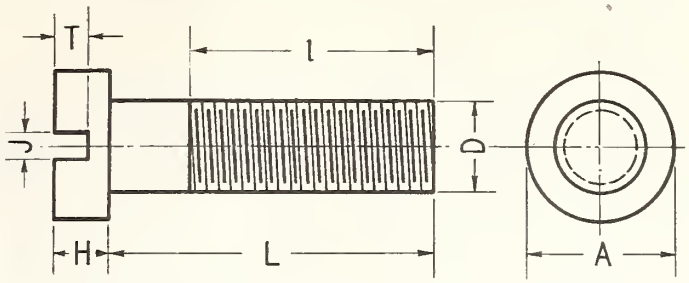


Nominal sizes	American National coarse-thread series, class 2 fit			American National fine-thread series, class 2 fit			Dimensions of head											
							D	*A*		*H*		*J*		*T*		*F*		*F* and *H*	
	Threads per inch	Body diameters		Threads per inch	Body diameters		Nominal diameter of wire	Diameter of head		Height of head		Width of slot		Depth of slot		Height of oval		Total height of head	
		Max	Min		Max	Min		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		Inch	*Inch*		*Inch*	*Inch*		*Inches*	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
0	.....	.....	.....	80	0.0600	(2)	0.060	0.096	0.082	0.045	0.037	0.022	0.016	0.025	0.019	0.014	0.006	0.059	0.043
1	64	0.0730	(2)	72	.0730	(2)	.073	.118	.103	.053	.045	.025	.019	.031	.020	.017	.009	.070	.054
2	56	.0860	(2)	64	.0860	(2)	.086	.140	.124	.055	.045	.036	.024	.037	.021	.028	.018	.083	.063
3	48	.0990	(2)	56	.0990	(2)	.099	.161	.145	.063	.052	.038	.026	.043	.026	.032	.021	.095	.073
4	40	.1120	(2)	48	.1120	(2)	.112	.183	.166	.072	.060	.040	.028	.048	.031	.035	.024	.107	.084
5	40	.1250	(2)	44	.1250	(2)	.125	.205	.187	.081	.068	.043	.031	.054	.036	.039	.027	.120	.095
6	32	.1380	(2)	40	.1380	(2)	.138	.226	.208	.089	.076	.045	.033	.060	.041	.043	.029	.132	.105
8	32	.1640	(2)	36	.1610	(2)	.164	.270	.250	.106	.091	.050	.037	.071	.050	.050	.035	.156	.126
10	24	.1900	(2)	32	.1900	(2)	.190	.313	.292	.123	.107	.055	.041	.083	.060	.057	.041	.180	.148
12	24	.2160	(2)	28	.2160	(2)	.216	.357	.334	.141	.123	.059	.045	.094	.070	.064	.047	.205	.169
¼	20	.2500	(2)	28	.2500	(2)	.250	.414	.389	.163	.143	.066	.051	.109	.083	.074	.054	.237	.197
5/16	18	.3125	(2)	24	.3125	(2)	.3125	.519	.490	.205	.181	.077	.061	.137	.106	.092	.068	.297	.249
⅜	16	.3750	(2)	24	.3750	(2)	.3750	.622	.590	.246	.218	.088	.072	.164	.129	.109	.082	.355	.300
7/16[1]	14	.4375	0.4277	20	.4375	0.4303	.4375	.625	.608	.297	.274	.098	.083	.168	.133	.071	.063	.368	.337
½[1]	13	.5000	.4896	20	.5000	.4928	.5000	.750	.731	.328	.301	.110	.094	.188	.148	.084	.075	.412	.376
9/16[1]	12	.5625	.5513	18	.5625	.5543	.5625	.812	.792	.375	.347	.123	.106	.214	.169	.091	.081	.466	.428
5/8[1]	11	.6250	.6132	18	.6250	.6168	.6250	.875	.853	.422	.392	.138	.119	.240	.190	.099	.088	.521	.480
¾[1]	10	.7500	.7372	16	.7500	.7410	.7500	1.000	.976	.500	.466	.154	.134	.283	.233	.112	.100	.612	.566
7/8[1]	9	.8750	.8610	14	.8750	.8652	.8750	1.125	1.098	.594	.556	.173	.151	.334	.264	.126	.113	.720	.669
1[1]	8	1.0000	.9848	14	1.0000	.9902	1.0000	1.312	1.282	.656	.613	.194	.170	.372	.292	.146	.131	.802	.744

[1] Sizes 7/16 inch and over are in agreement with ASA standard for cap screws, ASA B18c-1930.
[2] The minimum diameter of the unthreaded body is the same as the pitch diameter of the screw thread.

NOTE.—Dimensions in this table are subject to revision to bring them into agreement with revision of ASA B18c, now in preparation.

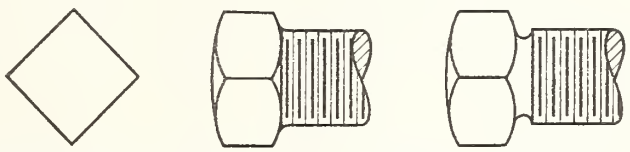
TABLE 132.—*Dimensions of flat-fillister-head machine screws*[1]



Nominal size	American National coarse-thread series, class 2 fit			American National fine-thread series, class 2 fit			Dimensions of head								
							D	*A*		*H*		*J*		*T*	
	Threads per inch	Body diameter		Threads per inch	Body diameter		Diameter of wire (nominal)	Diameter of head		Height of head		Width of slot		Depth of slot	
		Max	Min		Max	Min		Max	Min	Max	Min	Max	Min	Max	Min
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		Inch	*Inch*		*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
2	56	0.0860	0.0820	64	0.0860	0.0822	0.0860	0.140	0.124	0.083	0.063	0.036	0.024	0.037	0.021
3	48	.0990	.0946	56	.0990	.0950	.0990	.161	.145	.095	.073	.038	.026	.043	.026
4	40	.1120	.1072	48	.1120	.1076	.1120	.183	.166	.107	.084	.040	.028	.048	.031
5	40	.1250	.1202	44	.1250	.1204	.1250	.205	.187	.120	.095	.043	.031	.054	.036
6	32	.1380	.1326	40	.1380	.1332	.1380	.226	.208	.132	.105	.045	.033	.060	.041
8	32	.1640	.1586	36	.1640	.1590	.1640	.270	.250	.156	.126	.050	.037	.071	.050
10	24	.1900	.1834	32	.1900	.1846	.1900	.313	.292	.180	.148	.055	.041	.083	.060
12	24	.2160	.2094	28	.2160	.2098	.2160	.357	.334	.205	.169	.059	.045	.094	.070
¼	20	.2500	.2428	28	.2500	.2438	.2500	.414	.389	.237	.197	.066	.051	.109	.083
5/16	18	.3125	.3043	24	.3125	.3059	.3125	.519	.490	.297	.249	.077	.061	.137	.106
⅜	16	.3750	.3650	24	.3750	.3684	.3750	.622	.590	.355	.300	.088	.072	.164	.129

[1]This table is not included in ASA B18c-1930, nor in Bureau of Ships 42S5(INT).

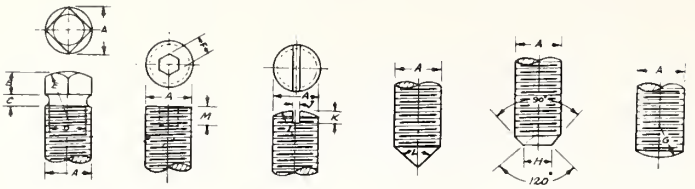
TABLE 133.—*Dimensions of square set screw heads*[1]



Nominal size or basic major diameter of thread	Width across flats		Width across corners	Height			Diameter of neck	
	Maximum (basic)	Minimum	Minimum	Nominal	Maximum	Minimum	Maximum	Minimum
1	2	3	4	5	6	7	8	9
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
¼ 0.2500	¼ 0.2500	0.241	0.331	5/16	0.196	0.178	0.185	0.170
5/16 .3125	5/16 .3125	.302	.415	15/64	.245	.224	.240	.225
⅜ .3750	⅜ .3750	.362	.497	9/32	.293	.270	.294	.279
7/16 .4375	7/16 .4375	.423	.581	21/64	.341	.315	.345	.330
½ .5000	½ .5000	.484	.665	⅜	.389	.361	.400	.385
9/16 .5625	9/16 .5625	.545	.748	27/64	.437	.407	.454	.439
⅝ .6250	⅝ .6250	.606	.832	15/32	.485	.452	.507	.492
¾ .7500	¾ .7500	.729	1.001	9/16	.582	.544	.620	.605
⅞ .8750	⅞ .8750	.852	1.170	21/32	.678	.635	.731	.716
1 1.0000	1 1.0000	.974	1.337	¾	.774	.726	.838	.823
1⅛ 1.1250	1⅛ 1.1250	1.096	1.505	27/32	.870	.817	.939	.914
1¼ 1.2500	1¼ 1.2500	1.219	1.674	15/16	.966	.908	1.064	1.039
1⅜ 1.3750	1⅜ 1.3750	1.342	1.843	1 1/32	1.063	1.000	1.159	1.134
1½ 1.5000	1½ 1.5000	1.464	2.010	1⅛	1.159	1.091	1.284	1.259

[1]This table is in agreement with table 6 of ASA B18.2-1941. For optional design see table 134.

TABLE 134.—*Dimensions of set screws*



A	*B*	*C*	*D*	*E*	*F* (min)	*G*	*H*	*I*	*J*	*K*
1	2	3	4	5	6	7	8	9	10	11
Inches	*Inch*	*Inch*	*Inches*	*Inches*	*Inch*	*Inch*	*Inch*	*Inches*	*Inch*	*Inch*
3/16	0.141	1/16	0.153 / .148	15/32	0.093	9/64	0.094	0.187	0.033	0.046
1/4	.187	5/64	.185 / .180	5/8	.125	3/16	.125	.250	.043	.062
5/16	.234	3/32	.240 / .235	25/32	.156	15/64	.172	.312	.054	.078
3/8	.281	1/8	.293 / .288	15/16	.187	9/32	.203	.375	.064	.093
7/16	.328	9/64	.344 / .339	1 3/32	.218	21/64	.234	.437	.075	.109
1/2	.375	9/64	.400 / .395	1 1/4	.250	3/8	.281	.500	.085	.125
9/16	.422	11/64	.454 / .449	1 13/32	.250	27/64	.312	.562	.095	.140
5/8	.469	3/16	.506 / .501	1 9/16	.312	15/32	.359	.625	.106	.156
3/4	.562	7/32	.620 / .615	1 7/8	.375	9/16	.438	.750	.127	.187
7/8	.656	1/4	.730 / .725	2 3/16	.500	21/32	.516	.875	.147	.218
1	.750	1/4	.837 / .832	2 1/2	.562	3/4	.594	1.000	.168	.250
1 1/8	.844	1/4	.939 / .934	2 13/16	.562	27/32	.672	1.125	.189	.281
1 1/4	.937	3/8	1.064 / 1.059	3 1/8	.625	15/16	.750	1.250	.210	.312

A = Diameter of screw and width across flats of square head.
B = Length of head = 0.75*A*.
C = Width of neck.
D = Diameter of neck = Minor diam. + 0.000 - 0.005.
E = Radius of square head screws = 2½*A*.
F = Width across flats.
G = Radius of round-point screws = ¾*A*.
H = Diameter of cup points.
I = Radius of slotted end on headless = *A*.
J = Width of slot = (*A* ÷ 6) + 0.002.
K = Depth of slot = (*A* ÷ 4).
L = Angle of cone point = 120° where length of screw is equal to or less than diameter of screw; 90° where length of screw is more than diameter of screw.
M = Minimum depth of socket = width across flats, *F*.

NOTE.—Dimensions in this table are subject to revision to bring them into agreement with revision of ASA B18c, now in preparation.

3. RECOMMENDED REQUIREMENTS, MACHINE-SCREW AND STOVE-BOLT NUTS

(*a*) WORKMANSHIP.—The workmanship shall be compatible with the type of product and class of fit and finish specified. The product shall be free from abnormal scale, fins, seams, or other defects. All nuts shall be free from any defects which might affect their serviceability.

Unless otherwise specified, nuts shall be either cold-punched, hot-forged and trimmed, or machined from bar stock.

(*b*) THREAD SERIES.—Unless otherwise specified machine screw nuts shall be threaded with the same class of fit as the machine screws to which they are to be

mated. When nuts are ordered separately the threads shall be of the thread series specified, and class 1 fit for numbered sizes, and class 2 fit for fractional sizes.

(*c*) DETAILS OF DESIGN.—1. *Taper of nuts.*—The taper of the sides of nuts (the angle between one side and the axis) shall not exceed 2°. The largest width shall not exceed the specified maximum width across flats.

2. *Top and bottom of nuts.*—The tops of hexagon nuts shall be flat and chamfered. The angle of chamfer with the top surface shall be 30°, and the diameter of the top circle shall be the maximum width across flats, within a tolerance of minus 15 percent. The bottoms of hexagon nuts are flat, or double chamfered, but for special purposes may be chamfered or washer faced if so specified.

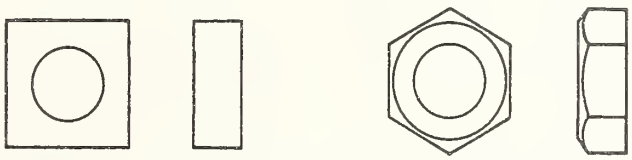
Square machine screw nuts and stove bolt nuts shall have tops and bottoms flat without chamfer.

3. *Bearing surface.*—The bearing surface shall be at right angles to the axis of the threaded hole within a tolerance of 1°.

4. TABLE OF DIMENSIONS, NUTS

The dimensions of square and hexagon machine screw and stove bolt nuts shall conform to table 135. The distance from the top to the bearing surface of a nut shall be regarded as the thickness of the nut.

TABLE 135.—*Dimensions of square and hexagon machine-screw and stove-bolt nuts*[1]



Nominal size	Width across flats		Width across corners (min.)		Thickness		
	Maximum (basic)	Minimum	Square	Hexagon	Nominal	Maximum	Minimum[3]
1	2	3	4	5	6	7	8
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
0	5/32 .1562	0.150	0.206	0.171	3/64	0.050	0.043
1	5/32 .1562	.150	.206	.171	3/64	.050	.043
2	3/16 .1875	.180	.247	.205	1/16	.066	.057
3	3/16 .1875	.180	.247	.205	1/16	.066	.057
4	1/4 .2500	.241	.331	.275	5/32	.098	.087
5[2]	5/16 .3125	.302	.415	.344	7/64	.114	.102
6	5/16 .3125	.302	.415	.344	7/64	.114	.102
8[2]	11/32 .3438	.332	.456	.378	1/8	.130	.117
10[2]	3/8 .3750	.362	.497	.413	1/8	.130	.117
12[2]	7/16 .4375	.423	.581	.482	5/32	.161	.148
1/4	7/16 .4375	.423	.581	.482	3/16	.193	.178
5/16	9/16 .5625	.545	.748	.621	7/32	.225	.208
3/8	5/8 .6250	.607	.833	.692	1/4	.257	.239

[1] This table is in agreement with table 10 of ASA B18.2-1941.

[2] These sizes in the coarse-thread series are interchangeable with the following sizes of stove-bolt nuts:

Machine screw	Stove bolt	Machine screw	Stove bolt
	Inch		*Inch*
No. 5	1/8	1/4 inch	1/4
No. 8	5/32	5/16 inch	5/16
No. 10	3/16	3/8 inch	3/8
No. 12	7/32		

[3] Minimum nut thicknesses of the following sizes are not sufficient to develop the full strength of screws, when minor diameters of nuts are at their maximum values: Nos. 0, 1, 2, 3, 10, 5/16, and 3/8 in.

SECTION XIV. SOCKET SET SCREWS, SOCKET-HEAD CAP SCREWS, AND SOCKET-HEAD SHOULDER SCREWS[30]

These standards for socket set screws and socket head cap screws, together with standards for wrenches for same, are intended for general use and to replace such other series of dimensions as have been used.

1. SERIES OF SOCKET SET SCREWS, SOCKET-HEAD CAP SCREWS, AND SOCKET SHOULDER SCREWS

Two series are covered by this standard, namely, hexagon socket screws and fluted socket screws.

2. RECOMMENDED REQUIREMENTS, SOCKET SET SCREWS

(*a*) WORKMANSHIP.—The workmanship shall be compatible with the type of product and class of fit and finish specified. The product shall be free from abnormal scale, fins, seams, or other defects. All screws shall be free from any defects which might affect their serviceability.

(*b*) THREAD SERIES.—Unless otherwise specified the number of threads per inch shall be that specified for the American National coarse-thread series.

(*c*) DETAILS OF DESIGN.—1. *Length of screws, L.*—The length of the screw shall be measured over all on a line parallel to the axis. The difference between consecutive lengths shall be as follows:

For screw lengths ¼ to ⅝ in., difference = 1/16 in.; for screw lengths ⅝ to 1 in., difference = ⅛ in.; for screw lengths 1 to 4 in., difference = ¼ in.; and for screw lengths 4 to 6 in., difference = ½ in.

Tolerance on length, *L*, shall be 3 percent on lengths 2 in. and under with a minimum of 0.020 in., one half to be applied plus and one half minus; on lengths over 2 in. to 6 in., ± 1/32 in.; and on lengths over 6 in., ± 1/16 in.

2. *Concentricity of dog point.*—The allowable eccentricity of dog-point axis with respect to axis of screw shall not exceed 3 percent of nominal diameter of screw with a minimum of 0.005 in.

3. *Chamfers and point angles.*—$W = 45° + 5° - 0°$; $X = 118° \pm 5°$; $Z = 35° + 5° - 0°$.

4. *Socket depth, T.*—The depth of the socket shall be as great as practicable, without weakening the wall between socket portion of head and body. Varying conditions render it inadvisable to specify definite values.

5. *Socket end chamfer, V.*—Socket end of screw shall be flat and chamfered. The flat shall be normal to the axis of the screw and the chamfer, *V*, shall be at an angle of $35° + 5° - 0°$ with the surface of the flat. The chamfer shall extend to the bottom of the thread, and the edge between flat and chamfer shall be slightly rounded.

(*d*) TABLES OF DIMENSIONS.—1. *Hexagon socket set screws.*—The dimensions of hexagon socket set screws shall conform to table 136.

2. *Fluted socket set screws.*—The dimensions of fluted socket set screws shall conform to table 137.

3. RECOMMENDED REQUIREMENTS, SOCKET-HEAD CAP SCREWS

(*a*) WORKMANSHIP.—The workmanship shall be compatible with the type of product and class of fit and finish specified. The product shall be free from abnormal scale, fins, seams, or other defects. All screws shall be free from any defects which might affect their serviceability.

(*b*) THREAD SERIES.—Unless otherwise specified the number of threads per inch shall be that specified for the American National coarse-thread series or the American National fine-thread series.

(*c*) DETAILS OF DESIGN.—1. *Length under head, L.*—The length of the screw shall be

[30] This standard is in agreement with that adopted by the American Standards Association, and published as ASA B18.3-1936, "Socket Set Screws and Socket Head Cap Screws" by the ASME, 29 West 39th St., New York 18, N. Y., (40c), and supplement ASA B18.3a-1944, (10c).

measured, on a line parallel to the axis, from the plane of the bearing surface under the head to the plane of the flat of the point. The difference between consecutive lengths shall be as follows: For screw lengths ¼ to 1 in., ⅛ in.; for screw lengths 1 to 4 in., ¼ in.; for screw lengths 4 to 6 in., ½ in.

The tolerance on the length, L, under the head, on lengths 2 in. and under shall be 3 percent of the nominal length with a minimum of 0.030 in., two thirds to be applied plus and one third minus; on lengths over 2 in. to 6 in., ± 1/32 in.; and on lengths over 6 in., ± 1/16 in.

2. *Thread length, l.*—The length of the screw thread is measured from the extreme point to the last usable thread and shall be as follows:

For American National coarse thread series.
- $l = 2D + ½$ in. (where this length of thread would be greater than half the screw length).
- $l = ½L$ (where this length of thread would be greater than $2D + ½$ in.).

For American National fine thread series.
- $l = 1½D + ½$ in. (where this length of thread would be greater than three-eighths the screw length).
- $l = ⅜\ L$ (where this length of thread would be greater than $1½D + ½$ in.

Screws too short to allow application of these formulas shall be threaded as close to the head as practicable.

3. *Tolerances on body diameter.*—Limiting dimensions for body diameter are given in tables 138 and 139.

4. *Screw-point chamfer, Z.*—The point shall be flat and chamfered. The flat shall be normal to the axis of the screw, and the chamfer, Z, shall be at an angle of 35° + 5°, -0° with the plane of the flat. The chamfer shall extend to the bottom of the thread, and edge between flat and chamfer shall be slightly rounded.

5. *Head chamfer, E.*—The head shall be flat and chamfered. The flat shall be normal to the axis of the screw, and the chamfer, E, shall be at an angle of 30° ± 2° with the surface of the flat. The edge between flat and chamfer shall be slightly rounded.

6. *Socket depth, T.*—The depth of socket shall be as great as practicable, without weakening the wall between socket portion of head and body. Varying conditions render it inadvisable to specify definite values for this dimension.

7. *Concentricity.*—The concentricity of head, body, and thread shall be such as to permit acceptance when checked with a compound "go" gage which will gage the maximum diameters of these three parts simultaneously. This gage shall have the head and body diameters at their maximum values (see columns D and A, tables 138 and 139), but expressed to four decimal places, and the pitch diameter at the maximum value allowed for class 3, NC and class 3, NF.

(*d*) Tables of Dimensions.—1. *Hexagon socket-head cap screws.*—The dimensions of hexagon socket-head cap screws shall conform to table 138.

2. *Fluted socket-head cap screws.*—The dimensions of fluted socket-head cap screws shall conform to table 139.

4. RECOMMENDED REQUIREMENTS, SOCKET-HEAD SHOULDER SCREWS

(*a*) Workmanship.—The workmanship shall be compatible with the type of product and class of fit and finish specified. The product shall be free from abnormal scale, fins, seams, or other defects. All screws shall be free from any defects which might affect their serviceability.

(*b*) Thread Series.—Unless otherwise specified the number of threads per inch shall be that specified for the American National coarse-thread series or the American National fine-thread series.

(*c*) Details of Design.—1. *Shoulder length, L.*—The length of the screw shall be measured on a line parallel to the axis, from the plane of the bearing surface under the head to the plane of the flat at neck.

Shoulder lengths shall be in ⅛-in. steps below 1 in., ¼-in. steps from 1 to 5 in., ½-in. steps from 5 to 7 in., and 1-in. steps over 7 in.

2. *Head chamfer, P.*—The head shall be flat and chamfered. The flat shall be

normal to the axis of the screw, and the chamfer, *P*, shall be at an angle of 30° ±2° with the surface of the flat. The edge between flat and chamfer shall be slightly rounded.

3. *Concentricity.*—The concentricity of head, body and thread shall be such as to permit acceptance when checked with a compound "go" gage which will gage the maximum diameters of these parts simultaneously. This gage shall have the head and body diameters at their maximum values but expressed to four decimal places.

4. *Screw point chamfer, Z.*—The point shall be flat and chamfered. The flat shall be normal to the axis of the screw, and the chamfer, *Z*, shall be at an angle of 35° + 5°-0° with the plane of the flat. The chamfer shall extend to the bottom of the thread. The edge between flat and chamfer shall be slightly rounded.

5. *Socket depth.*—The depth of socket shall be as great as practicable without weakening the wall between socket portion of head and body. Varying conditions render it inadvisable to specify definite values for this dimension.

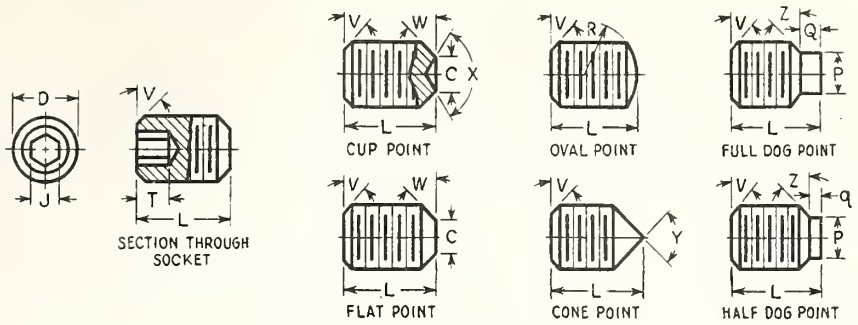
(*d*) TABLE OF DIMENSIONS.—The dimensions of hexagon and fluted socket-head shoulder screws shall conform to table 140.

5. WRENCHES, TABLES OF DIMENSIONS

(*a*) HEXAGON SOCKET WRENCHES.—The dimensions of wrenches for hexagon socket set screws and socket head cap screws shall conform to table 141.

(*b*) FLUTED SOCKET WRENCHES.—The dimensions of wrenches for fluted socket set screws and socket head cap screws shall conform to table 142.

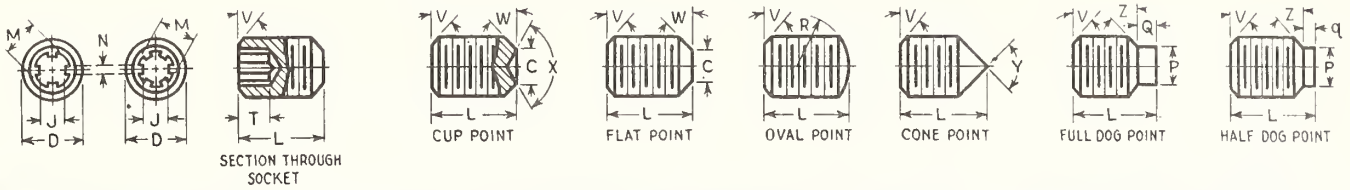
TABLE 136.—*Dimensions of hexagon socket set screws*



D	*C*			*R*	*Y*		*P*		*Q*	*q*	*J*	
Nominal size	Cup and flat point diameter			Oval point radius	Cone point angle		Full dog point and half dog point[1]				Socket width across flats	
	Mean	Maximum	Minimum		118° ± 2° for these lengths and under	90° ± 2° for these lengths and over	Diameter		Full	Half	Maximum	Minimum
							Maximum	Minimum				
1	2	3	4	5	6	7	8	9	10	11	12	13
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inch*	*Inch*	*Inches*	*Inch*
5.....	1/16	0.067	0.057	3/32	1/8	3/16	0.083	0.078	0.06	0.03	0.0635	1/16
6.....	.069	.074	.064	7/64	1/8	3/16	.092	.087	.07	.03	.0635	1/16
8.....	5/64	.087	.076	1/8	3/16	1/4	.109	.103	.08	.04	.0791	5/64
10.....	3/32	.102	.088	9/64	3/16	1/4	.127	.120	.09	.04	.0947	3/32
12.....	7/64	.115	.101	5/32	3/16	1/4	.144	.137	.11	.06	.0947	3/32
1/4.....	1/8	.132	.118	3/16	1/4	5/16	5/32	.149	1/8	1/16	.1270	1/8
5/16.....	11/64	.172	.156	15/64	5/16	3/8	13/64	.195	5/32	5/64	.1582	5/32
3/8.....	13/64	.212	.194	9/32	3/8	7/16	1/4	.241	3/16	3/32	.1895	3/16
7/16.....	15/64	.252	.232	21/64	7/16	1/2	19/64	.287	7/32	7/64	.2207	7/32
1/2.....	9/32	.291	.270	3/8	1/2	9/16	11/32	.334	1/4	1/8	.2520	1/4
9/16.....	5/16	.332	.309	27/64	9/16	5/8	25/64	.379	9/32	9/64	.2520	1/4
5/8.....	23/64	.371	.347	15/32	5/8	3/4	15/32	.456	5/16	5/32	.3155	5/16
3/4.....	7/16	.450	.425	9/16	3/4	7/8	9/16	.549	3/8	3/16	.3780	3/8
7/8.....	33/64	.530	.502	21/32	7/8	1	21/32	.642	7/16	7/32	.5030	1/2
1.....	19/32	.609	.579	3/4	1	1 1/8	3/4	.734	1/2	1/4	.5655	9/16
1 1/8.....	43/64	.689	.655	27/32	1 1/8	1 1/4	27/32	.826	9/16	9/32	.5655	9/16
1 1/4.....	3/4	.767	.733	15/16	1 1/4	1 1/2	15/16	.920	5/8	5/16	.6290	5/8
1 3/8.....	53/64	.848	.808	1 1/32	1 3/8	1 5/8	1 1/32	1.011	11/16	11/32	.6290	5/8
1 1/2.....	29/32	.926	.886	1 1/8	1 1/2	1 3/4	1 1/8	1.105	3/4	3/8	.7540	3/4
1 3/4.....	1 1/16	1.086	1.039	1 5/16	1 3/4	2	1 5/16	1.289	7/8	7/16	1.0040	1
2.....	1 7/32	1.244	1.193	1 1/2	2	2 1/4	1 1/2	1.474	1	1/2	1.0040	1

[1] Where usable length of thread is less than nominal diameter, half dog point shall be used.

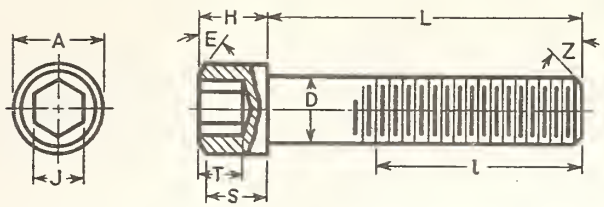
TABLE 137.—*Dimensions of fluted socket set screws*



D	C			R	Y		P		Q	q	Number of flutes	J		M		N	
Nominal size	Cup and flat point diameter			Oval point radius	Cone point angle		Full dog point and half dog point[1]					Socket diameter, minor		Socket diameter, major		Socket land width	
					118° ± 2° for these lengths and under	90° ± 2° for these lengths and over	Diameter		Full	Half							
	Mean	Maximum	Minimum				Maximum	Minimum				Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inch*	*Inch*		*Inches*	*Inches*	*Inches*	*Inches*	*Inch*	*Inch*
5	1/16	0.067	0.057	3/32	1/8	3/16	0.083	0.078	0.06	0.03	4	0.053	0.052	0.071	0.070	0.022	0.021
6	.069	.074	.064	7/64	1/8	3/16	.092	.087	.07	.03	4	.056	.055	.079	.078	.025	.024
8	5/64	.087	.076	1/8	3/16	1/4	.109	.103	.08	.04	6	.079	.078	.098	.097	.022	.021
10	3/32	.102	.088	9/64	3/16	1/4	.127	.120	.09	.04	6	.097	.095	.113	.111	.027	.025
12	7/64	.115	.101	5/32	3/16	1/4	.144	.137	.11	.06	6	.097	.095	.113	.111	.027	.025
1/4	1/8	.132	.118	3/16	1/4	5/16	5/32	.149	1/8	1/16	6	.127	.125	.147	.145	.032	.030
5/16	11/64	.172	.156	15/64	5/16	3/8	13/64	.195	5/32	5/64	6	.160	.158	.185	.183	.041	.040
3/8	13/64	.212	.194	9/32	3/8	7/16	1/4	.241	3/16	3/32	6	.190	.188	.219	.217	.052	.050
7/16	15/64	.252	.232	21/64	7/16	1/2	19/64	.287	7/32	7/64	6	.221	.219	.256	.254	.062	.060
1/2	9/32	.291	.270	3/8	1/2	9/16	11/32	.334	1/4	1/8	6	.254	.252	.297	.295	.072	.070
9/16	5/16	.332	.309	27/64	9/16	5/8	25/64	.379	9/32	9/64	6	.254	.252	.297	.295	.072	.070
5/8	23/64	.371	.347	15/32	5/8	3/4	15/32	.456	5/16	5/32	6	.315	.312	.380	.377	.092	.089
3/4	7/16	.450	.425	9/16	3/4	7/8	9/16	.549	3/8	3/16	6	.386	.383	.463	.460	.112	.109
7/8	33/64	.530	.502	21/32	7/8	1	21/32	.642	7/16	7/32	6	.506	.503	.600	.597	.142	.139
1	19/32	.609	.579	3/4	1	1 1/8	3/4	.734	1/2	1/4	6	.568	.564	.654	.650	.157	.153
1 1/8	43/64	.689	.655	27/32	1 1/8	1 1/4	27/32	.826	9/16	9/32	6	.568	.564	.654	.650	.157	.153
1 1/4	3/4	.767	.733	15/16	1 1/4	1 1/2	15/16	.920	5/8	5/16	6	.631	.627	.790	.786	.184	.180
1 3/8	53/64	.848	.808	1 1/32	1 3/8	1 5/8	1 1/32	1.011	11/16	11/32	6	.631	.627	.790	.786	.184	.180
1 1/2	29/32	.926	.886	1 1/8	1 1/2	1 3/4	1 1/8	1.105	3/4	3/8	6	.756	.752	.958	.954	.221	.217
1 3/4	1 1/16	1.086	1.039	1 5/16	1 3/4	2	1 5/16	1.289	7/8	7/16	6	1.007	1.003	1.275	1.271	.298	.294
2	1 7/32	1.244	1.193	1 1/2	2	2 1/4	1 1/2	1.474	1	1/2	6	1.007	1.003	1.275	1.271	.298	.294

[1] Where usable length of thread is less than nominal diameter, half dog point shall be used.

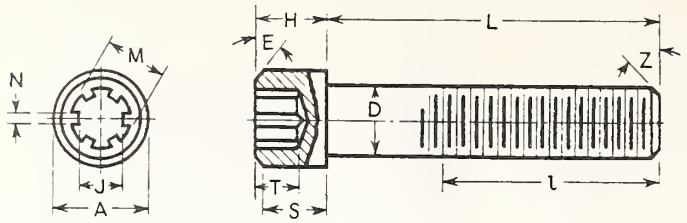
TABLE 138.—*Dimensions of hexagon socket head cap screws*



D			*A*		*H*		*S*			*J*	
Body diameter[1]			Head diameter		Head height		Head side-height			Socket, width across flats	
Nominal	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Nominal	Maximum	Minimum	Maximum	Minimum
1	2	3	4	5	6	7	8	9	10	11	12
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inch*
8	0.1640	0.1613	9/32	0.276	0.164	0.160	0.1503	0.1522	0.1484	0.1270	1/8
10	.1900	.1867	5/16	.306	.190	.185	.1741	.1765	.1717	.1582	5/32
12	.2160	.2127	11/32	.337	.216	.211	.1980	.2005	.1957	.1582	5/32
1/4	.2500	.2464	3/8	.367	1/4	.244	.2291	.2317	.2265	.1895	3/16
5/16	.3125	.3084	7/16	.429	5/16	.306	.2864	.2894	.2834	.2207	7/32
3/8	.3750	.3705	9/16	.553	3/8	.368	.3437	.3469	.3405	.3155	5/16
7/16	.4375	.4326	5/8	.615	7/16	.430	.4010	.4046	.3974	.3155	5/16
1/2	.5000	.4948	3/4	.739	1/2	.492	.4583	.4620	.4546	.3780	3/8
9/16	.5625	.5569	13/16	.801	9/16	.554	.5156	.5196	.5116	.3780	3/8
5/8	.6250	.6191	7/8	.863	5/8	.616	.5729	.5771	.5687	.5030	1/2
3/4	.7500	.7436	1	.987	3/4	.741	.6875	.6920	.6830	.5655	9/16
7/8	.8750	.8680	1 1/8	1.111	7/8	.865	.8020	.8069	.7971	.5655	9/16
1	1.0000	.9924	1 5/16	1.297	1	.989	.9166	.9220	.9112	.6290	5/8
1 1/8	1.1250	1.1165	1 1/2	1.483	1 1/8	1.113	1.0312	1.0372	1.0254	.7540	3/4
1 1/4	1.2500	1.2415	1 3/4	1.733	1 1/4	1.238	1.1457	1.1516	1.1398	.7540	3/4
1 3/8	1.3750	1.3649	1 7/8	1.855	1 3/8	1.361	1.2604	1.2675	1.2533	.7540	3/4
1 1/2	1.5000	1.4899	2	1.979	1 1/2	1.485	1.3750	1.3821	1.3679	1.0040	1

[1]Body diameter, *D*, refers to the unthreaded portion, and is the nominal diameter of the screw, with a minus tolerance.

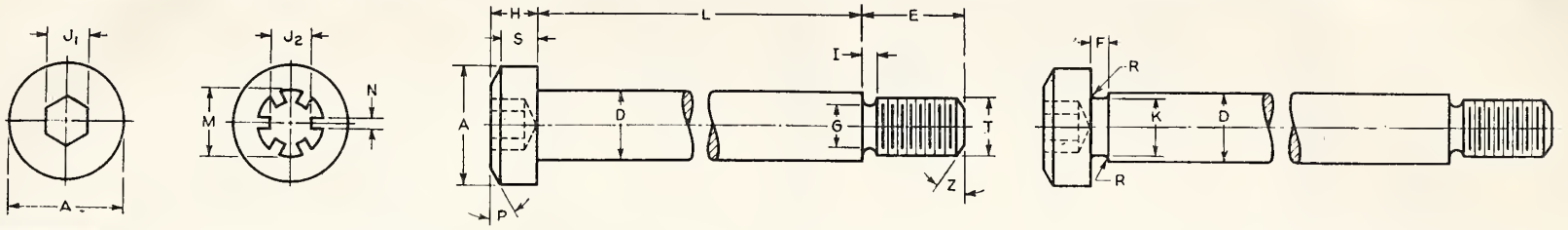
TABLE 139.—*Dimensions of fluted socket head cap screws*



D			A		B		S			Number of flutes	J		M		N	
Body diameter[1]			Head diameter		Head height		Head side-height				Socket diameter, minor		Socket diameter, major		Width of socket land	
Nominal	Max	Min	Max	Min	Max	Min	Nominal	Max	Min		Max	Min	Max	Min	Max	Min
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*		*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
8.....	0.1610	0.1613	9/32	0.276	0.161	0.160	0.1503	0.1522	0.1484	6	0.127	0.125	0.147	0.145	0.035	0.033
10.....	.1900	.1867	5/16	.306	.190	.185	.1741	.1765	.1717	6	.127	.125	.147	.145	.035	.033
12.....	.2160	.2127	11/32	.337	.216	.211	.1980	.2005	.1957	6	.160	.158	.185	.183	.042	.040
1/4....	.2500	.2464	3/8	.367	1/4	.244	.2291	.2317	.2265	6	.190	.188	.219	.217	.052	.050
5/16...	.3125	.3084	7/16	.429	5/16	.306	.2864	.2894	.2834	6	.221	.219	.256	.254	.062	.060
3/8....	.3750	.3705	9/16	.553	3/8	.368	.3437	.3469	.3405	6	.312	.310	.380	.378	.092	.090
7/16...	.4375	.4326	5/8	.615	7/16	.430	.4010	.4046	.3974	6	.312	.310	.380	.378	.092	.090
1/2....	.5000	.4948	3/4	.739	1/2	.492	.4583	.4620	.4645	6	.386	.383	.463	.460	.112	.109
9/16...	.5625	.5569	13/16	.801	9/16	.551	.5156	.5196	.5116	6	.386	.383	.463	.460	.112	.109
5/8....	.6250	.6191	7/8	.863	5/8	.616	.5729	.5771	.5687	6	.506	.503	.000	.597	.142	.139
3/4....	.7500	.7436	1	.987	3/4	.741	.6875	.6920	.6830	6	.568	.564	.654	.650	.157	.153
7/8....	.8750	.8680	1 1/8	1.111	7/8	.865	.8020	.8069	.7971	6	.568	.564	.654	.650	.157	.153
1.....	1.0000	.9924	1 5/16	1.297	1	.989	.9166	.9220	.9112	6	.631	.627	.790	.786	.184	.180
1 1/8....	1.1250	1.1165	1 1/2	1.483	1 1/8	1.113	1.0312	1.0372	1.0254	6	.756	.752	.957	.953	.221	.217
1 1/4....	1.2500	1.2415	1 3/4	1.733	1 1/4	1.238	1.1457	1.1516	1.1398	6	.756	.752	.957	.953	.221	.217
1 3/8....	1.3750	1.3649	1 7/8	1.855	1 3/8	1.361	1.2604	1.2675	1.2533	6	.756	.752	.957	.953	.221	.217
1 1/2....	1.5000	1.4899	2	1.979	1 1/2	1.485	1.3750	1.3821	1.3679	6	1.007	1.003	1.275	1.271	.298	.294

[1]Body diameter, *D*, refers to the unthreaded portion, and is the nominal diameter of the screw, with a minus tolerance.

TABLE 140.—*Dimensions of hexagon and fluted-type socket-head shoulder screws (stripper bolts)*[1]; *optional*

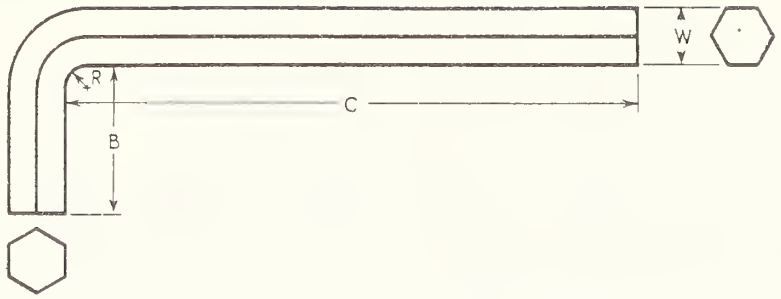


Shoulder or screw diameter,[2] *D*			Head diameter, *A*		Head height, *H*		Head side-height, *S*			Screw thread, *T*	Length of thread, *E*	Shoulder length, *L*
Nominal	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Nominal	Maximum	Minimum			
1	2	3	4	5	6	7	8	9	10	11	12	13
Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*		*Inches*	*Inches*
1/4	0.2480	0.2460	3/8	0.367	3/16	0.182	0.1615	0.1641	0.1589	10-24 NC-3	3/8 ±0.010	3/4 to 2 1/2 ±0.005
5/16	.3105	.3085	7/16	.429	7/32	.213	.1869	.1899	.1839	1/4-20 NC-3	7/16 ± .010	1 to 3 ± .005
3/8	.3730	.3710	9/16	.553	1/4	.244	.2123	.2155	.2091	5/16-18 NC-3	1/2 ± .010	1 to 4 ± .005
1/2	.4980	.4960	3/4	.739	5/16	.306	.2631	.2668	.2594	3/8-16 NC-3	5/8 ± .015	1 1/4 to 5 ± .005
5/8	.6230	.6210	7/8	.863	3/8	.368	.3139	.3181	.3097	1/2-13 NC-3	3/4 ± .015	1 1/2 to 6 ± .005
3/4	.7480	.7460	1	.987	1/2	.492	.4296	.4341	.4251	5/8-11 NC-3	7/8 ± .015	1 1/2 to 8 ± .005
1	.9980	.9960	1 5/16	1.297	5/8	.616	.5312	.5366	.5258	3/4-10 NC-3	1 ± .015	1 1/2 to 8 ± .005
1 1/4	1.2480	1.2460	1 3/4	1.733	3/4	.741	.6327	.6386	.6268	7/8-9 NC-3	1 1/8 ± .015	1 1/2 to 8 ± .005

Shoulder or screw diameter,[2] *D*	Diameter of neck, *G*		Width of neck,[3] *I*	Socket width across flats, J_1		Socket diameter, minor, J_2		Socket diameter, major, *M*		Width of socket land, *N*		Diameter of neck, *K*[1]		Width of neck, *P*[1]	Fillet, *R*[1]	
Nominal	Maximum	Minimum		Maximum	Minimum	Maximum	Minimum	Maximum	Mininum	Maximum	Minimum	Maximum	Minimum		Maximum	Minimum
1	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
1/4	0.145	0.136	1/16	0.1270	1/8	0.127	0.125	0.147	0.145	0.032	0.030	0.243	0.240	3/32	0.020	0.015
5/16	.196	.185	5/64	.1582	5/32	.160	.158	.185	.183	.041	.040	.305	.302	3/32	.020	.015
3/8	.252	.240	5/64	.1895	3/16	.190	.188	.219	.217	.052	.050	.368	.365	3/32	.025	.020
1/2	.307	.294	3/32	.2520	1/4	.254	.252	.297	.295	.072	.070	.493	.490	3/32	.025	.020
5/8	.417	.400	1/8	.3155	5/16	.315	.312	.380	.377	.092	.089	.618	.615	3/32	.030	.025
3/4	.526	.507	9/64	.3780	3/8	.386	.383	.463	.460	.112	.109	.743	.740	3/32	.030	.025
1	.642	.620	5/32	.5030	1/2	.506	.503	.600	.597	.142	.139	.993	.990	1/8	.035	.030
1 1/4	.755	.731	11/64	.6290	5/8	.631	.627	.790	.786	.184	.180	1.243	1.240	1/8	.035	.030

[1] Neck under head is optional with manufacturers.
[2] Body or shoulder, *D*, refers to the unthreaded portion and denotes the nominal diameter (or size) of the shoulder screw.
[3] Minimum radius 0.03 in. (at corners of neck bottom), *G*.

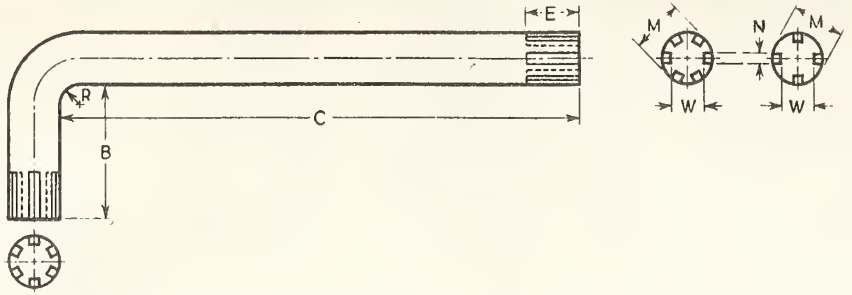
TABLE 141.—*Dimensions of wrenches for hexagon socket set screws and socket head caps screws*



D		W		B		C				R
Screw size		Hexagon width across flats		Length, short arm		Length, long arm				Radius of bend
						Short series		Long series		
Set	Cap	Maximum	Minumum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	
1	2	3	4	5	6	7	8	9	10	11
		Inch	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inch*
5		1/16	0.0615	21/32	15/32	1 27/32	1 21/32	.....	.....	1/16
6		1/16	.0615	21/32	15/32	1 27/32	1 21/32	.....	.....	1/16
8		5/64	.0771	45/64	33/64	1 31/32	1 25/32	.....	.....	5/64
10		3/32	.0927	3/4	9/16	2 3/32	1 29/32	.....	.....	3/32
12		3/32	.0927	3/4	9/16	2 3/32	1 29/32	.....	.....	3/32
1/4	8	1/8	.1235	27/32	21/32	2 11/32	2 5/32	3 27/32	3 21/32	1/8
5/16	10, 12	5/32	.1547	15/16	3/4	2 19/32	2 13/32	4 7/32	4 1/32	5/32
3/8	1/4	3/16	.1860	1 1/32	27/32	2 27/32	2 21/32	4 19/32	4 13/32	3/16
7/16	5/16	7/32	.2172	1 1/8	15/16	3 3/32	2 29/32	4 31/32	4 25/32	7/32
1/2	.....	1/4	.2485	1 7/32	1 1/32	3 11/32	3 5/32	5 11/32	5 5/32	1/4
9/16	.....	1/4	.2485	1 7/32	1 1/32	3 11/32	3 5/32	5 11/32	5 5/32	1/4
5/8	3/8, 7/16	5/16	.3110	1 11/32	1 5/32	3 27/32	3 21/32	6 3/32	5 29/32	5/16
3/4	1/2, 9/16	3/8	.3735	1 15/32	1 9/32	4 11/32	4 5/32	6 27/32	6 21/32	3/8
7/8	5/8	1/2	.4985	1 23/32	1 17/32	5 11/32	5 5/32	8 11/32	8 5/32	1/2
1	.....	9/16	.5600	1 27/32	1 21/32	5 27/32	5 21/32	9 3/32	8 29/32	9/16
1 1/8	3/4, 7/8	9/16	.5600	1 27/32	1 21/32	5 27/32	5 21/32	9 3/32	8 29/32	9/16
1 1/4, 1 3/8	1	5/8	.6225	1 31/32	1 25/32	6 1/32	6 5/32	9 27/32	9 21/32	5/8
1 1/2	1 1/8, 1 1/4, 1 3/8	3/4	.7475	2 7/32	2 1/32	7 11/32	7 5/32	11 11/32	11 5/32	3/4
1 3/4	.....	1	.9975	2 23/32	2 17/32	9 11/32	9 5/32	14 11/32	14 5/32	1
2	1 1/2	1	.9975	2 23/32	2 17/32	9 11/32	9 5/32	14 11/32	14 5/32	1

TABLE 142.—*Dimensions of wrenches for fluted socket set screws and socket head cap screws*

TABLE 142.—*Dimensions of wrenches for fluted socket set screws and socket head cap screws*



D		M		W		Number of flutes	N		E	B		C				R
Screw size		Major diameter		Minor diameter			Width of flute		Length of flute	Length, short arm		Length, long arm				Radius of bend
												Short series		Long series		
Set	Cap	Maximum	Minimum	Maximum	Minimum		Maximum	Minimum		Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		Inches	*Inches*	*Inch*	*Inch*		*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inch*
5		0.0690	0.0680	0.0510	0.0500	4	0.0260	0.0250	1/8	21/32	15/32	1 27/32	1 21/32	.....	.....	1/16
6		.0760	.0750	.0530	.0520	4	.0280	.0270	1/8	21/32	15/32	1 27/32	1 21/32	.....	.....	1/16
8		.0940	.0930	.0780	.0765	6	.0260	.0250	1/8	45/64	33/64	1 31/32	1 25/32	.....	.....	5/64
10		.1100	.1090	.0940	.0925	6	.0290	.0280	5/32	3/4	9/16	2 3/32	1 29/32	.....	.....	3/32
12		.1100	.1090	.0940	.0925	6	.0290	.0280	5/32	3/4	9/16	2 3/32	1 29/32	.....	.....	3/32
1/4	8	.1440	.1425	.1230	.1205	6	.0370	.0355	3/16	27/32	21/32	2 11/32	2 5/32	3 27/32	3 21/32	1/8
5/16	10, 12	.1830	.1815	.1580	.1565	6	.0440	.0425	7/32	15/16	3/4	2 19/32	2 13/32	4 7/32	4 1/32	5/32
3/8	1/4	.2160	.2145	.1720	.1705	6	.0550	.0535	1/4	1 1/32	27/32	2 27/32	2 2 1/32	4 19/32	4 13/32	3/16
7/16	5/16	.2510	.2495	.2010	.1995	6	.0655	.0640	9/32	1 1/8	15/16	3 3/32	2 29/32	4 31/32	4 25/32	7/32
1/2		.2910	.2895	.2390	.2375	6	.0775	.0760	5/16	1 7/32	1 1/32	3 11/32	3 5/32	5 11/32	5 5/32	1/4
9/16		.3310	.3295	.2730	.2715	6	.0875	.0860	11/32	1 7/32	1 1/32	3 11/32	3 5/32	5 11/32	5 5/32	9/32
5/8	3/8, 7/16	.3720	.3705	.3070	.3055	6	.0975	.0960	3/8	1 11/32	1 5/32	3 27/32	3 21/32	6 3/32	5 29/32	5/16
3/4	1/2, 9/16	.4540	.4525	.3770	.3755	6	.1185	.1170	7/16	1 15/32	1 9/32	4 11/32	4 5/32	6 27/32	6 21/32	3/8
7/8	5/8	.5950	.5935	.5000	.4975	6	.1460	.1445	1/2	1 23/32	1 17/32	5 11/32	5 5/32	8 11/32	8 5/32	1/2
1		.6480	.6455	.5620	.5595	6	.1590	.1565	9/16	1 27/32	1 21/32	5 27/32	5 21/32	9 3/32	8 29/32	1/2
1 1/8	3/4, 7/8	.6480	.6455	.5620	.5595	6	.1615	.1590	5/8	1 27/32	1 21/32	5 27/32	5 21/32	9 3/32	8 29/32	9/16
1 1/4, 1 3/8	1	.7840	.7815	.6250	.6225	6	.1875	.1850	11/16	1 31/32	1 25/32	6 11/32	6 5/32	9 27/32	9 21/32	5/8
1 1/2	1 1/8, 1 1/4, 1 3/8	.9550	.9525	.7500	.7475	6	.2245	.2220	13/16	2 7/32	2 1/32	7 11/32	7 5/32	11 11/32	11 5/32	3/4
1 3/4		1.2680	1.2655	1.0000	.9975	6	.3015	.2990	15/16	2 23/32	2 17/32	9 11/32	9 5/32	14 11/32	14 5/32	7/8
2	1 1/2	1.2680	1.2655	1.0000	.9975	6	.3015	.2990	1 1/16	2 23/32	2 17/32	9 11/32	9 5/32	14 11/32	14 5/32	1

APPENDIX 1. DERIVATION OF TOLERANCES

1. PITCH DIAMETER TOLERANCES

(*a*) TOLERANCES FOR STANDARD THREAD SERIES.—The tolerances for screw threads specified in section III were arrived at by combining two factors, known as the net pitch diameter tolerance and the gage tolerance. The theoretical net tolerances for all screws and nuts of a given class of fit bear a definite mathematical relationship to each other, and it was intended that these should in no way be reduced by permissible manufacturing tolerances for master gages; that is, gages within the original gage tolerances in the 1921 NSTC Progress Report, which were approximately equivalent to class X tolerances. Consequently the net tolerances were increased by the equivalent diametrical space required to provide for the gage tolerances on diameter, lead, and angle, to produce the extreme tolerances specified for the product. In practice, the actual net tolerances will depend upon the method of gaging and upon the accuracy of the gages used.

The net pitch diameter tolerances for the various classes of fit are based on the following series for a pitch of $\frac{1}{20}$ inch:

	Inch
Class 1 fit	0.0045
Class 2 fit	.0030
Class 3 fit	.0020
Class 4 fit	.0010

Pitch diameter tolerances for pitches finer than $\frac{1}{20}$ inch are to each other and to the tolerance for $\frac{1}{20}$ inch as the 0.6th power of their respective pitches.

Pitch diameter tolerances for pitches coarser than $\frac{1}{20}$ inch are to each other and to the tolerance for $\frac{1}{20}$ inch as the 0.9th power of their respective pitches.

The exponent 0.6 was chosen for pitches finer than $\frac{1}{20}$ inch because the resulting tolerances, except in two instances, do not vary more than 0.0001 inch from the pitch diameter tolerances specified in the ASME Machine Screw Standard.

(*b*) TOLERANCES FOR SCREW THREADS OF SPECIAL DIAMETERS, PITCHES, AND LENGTHS OF ENGAGEMENT.—As stated in section V, the pitch diameter tolerances for special sizes of threads of American National form as given in tables 55, 56, 57, and 58 were obtained by adding three values, or increments, one dependent upon the basic major diameter, another upon the length of engagement, and the third upon the pitch, except that pitch diameter tolerances listed in section III were inserted in the tables in the positions corresponding to standard sizes, pitches, and lengths of engagement of the American National coarse and fine thread series, and values above and to the left of these inserted values were reduced where necessary so that none should exceed these standard values. Likewise values below and to the right of these inserted values were increased where necessary so that none should be less than these standard values. The formulas from which the increments are derived are given in table 143.

TABLE 143.—*Schedule of tolerance increments for special threads*[1]

Class of fit	Diameter increment	Length of engagement increment	Pitch increment
1	2	3	4
Class 1 fit	$0.002\sqrt{D}$	0.0020	$0.020\sqrt{p}$
Class 2 fit	$.002\sqrt{D}$	.0020	$.010\sqrt{p}$
Class 3 fit	$.002\sqrt{D}$	.0020	$.005\sqrt{p}$
Class 4 fit	$.001\sqrt{D}$	.0010	$.0025\sqrt{p}$

[1]For the 8-, 12-, and 16- pitch thread series, and the extra-fine thread series, the class 3 tolerances are 70 percent of the class 2 tolerances as derived from these formulas. See footnote 1, tables 32, 37, 42, and 47.

2. RELATION OF LEAD AND ANGLE ERRORS TO PITCH DIAMETER TOLERANCES

It has been stated in various sections of the handbook that the tolerances specified for pitch diameter of product include all errors of pitch diameter, lead, and angle. Also, there were tabulated the errors in lead and angle, each of which could be compensated for by one half of the specified pitch diameter tolerances. These equivalents were derived from definite mathematical relations, which are given below.

(*a*) DIAMETER EQUIVALENT OF LEAD ERRORS.—The formula expressing the relation between lead error between any two threads within the length of engagement and its diameter equivalent is as follows:

$$E' = (\pm p') \cot a,$$

in which

E' = pitch diameter increment due to lead error
p' = the maximum pitch error between any two of the threads engaged
a = half angle of thread

The quantity E' is always added to the measured pitch diameter in the case of an external thread, and it is always subtracted in the case of an internal thread, regardless of the sign introduced by the lead error p'.

For threads of American National form, the above formula reduces to—

$$E' = 1.7321\ p'.$$

For threads of Acme form the above formula reduces to

$$E' = 3.8667\ p'.$$

(*b*) Diameter Equivalent of Angle Error.—The general formula expressing the relation between error in the half angle of thread and its diameter equivalent—that is, the amount of the pitch diameter tolerance absorbed by such an error—is:

$$\cot a' = \frac{h}{E'' \sin a \cos a} \pm \cot a,$$

in which

E'' = pitch diameter increment due to error in half angle
h = basic thread depth
a = basic half angle of thread
a' = error in half angle of thread.

In solving for E'' the average value of a' for the two sides of the thread, regardless of their signs, should be taken. The sign of cot a is plus when the half angle of thread is less than basic, and minus when the half angle is greater than basic. By omitting $\pm$ cot a from the formula an approximate mean value for a' or E'' is obtained which differs very little from either extreme value. The Committee has, therefore, adopted for general use the formula

$$\cot a' = \frac{h}{E'' \sin a \cos a}.$$

For threads of American National form, this formula reduces to

$$\cot a' = \frac{3p}{2E''}$$

or

$$E'' = 1.5\ p \tan a'.$$

For the form of thread recommended for pipe-thread gages, the formula becomes

$$\cot a' = \frac{1.53812p}{E''}$$

or

$$E'' = \frac{1.53812}{n} \tan a'.$$

For the Acme form of thread, the formula becomes

$$\cot a' = \frac{2.06267p}{E''}$$

or

$$E'' = \frac{2.06267}{n} \tan a'.$$

APPENDIX 2. WIRE METHODS OF MEASUREMENT OF PITCH DIAMETER

Throughout this handbook emphasis has been placed on pitch diameter tolerances and limits, as upon these the fit of a screw thread largely depends. The maintenance of these tolerances and limits requires the use of limit thread gages, and these, in turn, depend upon the absolute values or measurements of master gages. The measurement of pitch diameter presents certain difficulties which may result in an uncertainty as to its true value. The adoption of a uniform practice in making such measurement is, therefore, desirable. The so-called "three-wire method" of measuring pitch diameter, as here outlined, has been found to be the most accurate and satisfactory when properly carried out, and is recommended for universal use in the direct measurement of thread-plug gages.

1. SIZE OF WIRES

In the three-wire method of measuring pitch diameter small hardened steel cylinders or wires of correct size are placed in the thread groove, two on one side of the screw and one on the opposite side, as shown in figure 37. The contact face of the micrometer anvil or spindle over the two wires must be sufficiently large in diameter to touch both wires; that is, the diameter must be greater than the pitch of the thread. It is best to select wires of such a size that they touch the sides of the thread at the midslope, for the reason that the measurement of pitch diameter is least affected by any error in thread angle which may be present when such size is used. The size of wire which touches exactly at the midslope of a perfect thread of a given pitch is termed the "best-size" wire for that pitch. Any size, however, may be used which will permit the wires to rest on the sides of the thread and also project above the top of the thread.

The depth at which a wire of given diameter will rest in a thread groove depends primarily on the pitch and included angle of the thread; and secondarily, on the angle made by the helix, at the point of contact of the wire and the thread, with a plane perpendicular to the axis of the screw. Inasmuch as variation in the helix angle has a very small effect in determining the diameter of the wire which touches at the midslope of the thread, and as it is desirable to use one size of wire to measure all

threads of a given pitch and included angle, the best size wire is taken as that size which will touch at the midslope of a groove cut around a cylinder perpendicular to the axis of the cylinder, and of the same angle and depth as the thread of the given pitch. This is equivalent to a thread of zero helix angle. The size of wire touching at the midslope, or "best-size" wire, is given by the formula

$$G = \frac{p}{2} \sec a,$$

in which

G = diameter of wire
p = pitch
a = ½ included angle of thread

This formula reduces to

$$G = 0.57735 \times p, \text{ for } 60° \text{ threads.}$$

It is frequently desirable, as, for example, when a best-size wire is not available, to measure pitch diameter by means of wires of other than the best size. The minimum size which may be used is limited to that permitting the wire to project above the crest of the thread, and the maximum to that permitting the wire to rest on the sides of the thread just below the crest, and not ride on the crest of the thread. The diameters of the best size, maximum, and minimum wires for American National coarse, fine, hose-coupling, and pipe threads are given in tables 144 and 146.

The diameters of the best size, maximum, and minimum wires for standard pitches of Acme threads are listed in table 145.

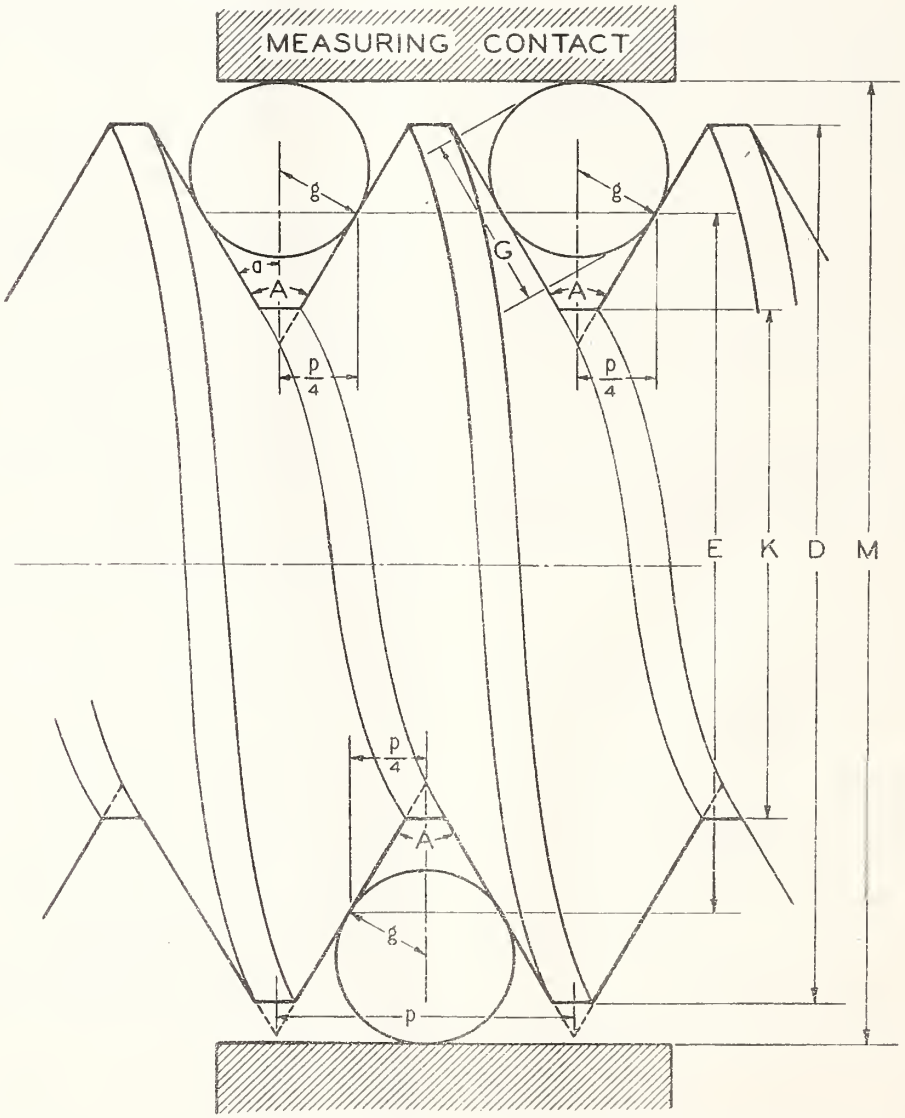


FIGURE 37.—*Three-wire method of measuring pitch diameter of thread plug gages.*

TABLE 144.—*Wire sizes and constants, American National coarse, fine, hose coupling, and pipe threads*

Wire sizes[1]			Threads per inch, n	Pitch, $p = \frac{1}{n}$	$\frac{\text{Pitch}}{2}$, $\frac{p}{2} = \frac{1}{2n}$	Depth of V thread, $\frac{\cot 30°}{2n}$
Best, $0.577350p$	Maximum, $1.010363p$	Minimum, $0.505182p$				
1	2	3	4	5	6	7
Inch	*Inch*	*Inch*		*Inch*	*Inch*	*Inch*
0.00722	0.01263	0.00631	80	0.01250	0.00625	0.01083
.00802	.01403	.00702	72	.01389	.00694	.01203
.00902	.01579	.00789	64	.01562	.00781	.01353
.01031	.01804	.00902	56	.01786	.00893	.01546
.01203	.02105	.01052	48	.02083	.01042	.01804
.01312	.02296	.01148	44	.02273	.01136	.01968
.01443	.02526	.01263	40	.02500	.01250	.02165
.01604	.02807	.01403	36	.02778	.01389	.02406
.01804	.03157	.01579	32	.03125	.01562	.02706
.02062	.03608	.01804	28	.03571	.01786	.03093
.02138	.03742	.01871	27	.03704	.01852	.03208
.02406	.04210	.02105	24	.04167	.02083	.03608
.02887	.05052	.02526	20	.05000	.02500	.04330
.03208	.05613	.02807	18	.05556	.02778	.04811
.03608	.06315	.03157	16	.06250	.03125	.05413
.04124	.07217	.03608	14	.07143	.03571	.06186
.04441	.07772	.03886	13	.07692	.03846	.06662
.04811	.08420	.04210	12	.08333	.04167	.07217
.05020	.08786	.04393	11½	.08696	.04348	.07531
.05249	.09185	.04593	11	.09091	.04545	.07873
.05773	.10104	.05052	10	.10000	.05000	.08660
.06415	.11226	.05613	9	.11111	.05556	.09623
.07217	.12630	.06315	8	.12500	.06250	.10825
.07698	.13472	.06736	7½	.13333	.06667	.11547
.08248	.14434	.07217	7	.14286	.07143	.12372
.09623	.16839	.08420	6	.16667	.08333	.14434
.11547	.20207	.10104	5	.20000	.10000	.17321
.12830	.22453	.11226	4½	.22222	.11111	.19245
.14434	.25259	.12630	4	.25000	.12500	.21651

[1]These wire sizes are based on zero helix angle. Also maximum and minimum sizes are based on a width of flat at the crest equal to $\frac{1}{8} \times p$. The width of flat of American National pipe thread gages is slightly less than this, so that the minimum size listed is slightly too small for such gages. In any case the use of wires of either extreme size is to be avoided.

TABLE 145.—*Wire sizes and constants, Acme threads (29°)*

Threads per inch	Pitch, $p = \frac{1}{n}$	Wire sizes[1]		
		Best, $0.516450p$	Maximum, $0.650013p$	Minimum, $0.487263p$
1	2	3	4	5
	Inch	*Inch*	*Inch*	*Inch*
1	1.00000	0.51645	0.65001	0.48726
1⅓	.75000	.38734	.48751	.36545
1½	.66667	.34430	.43334	.32484
2	.50000	.25822	.32501	.24363
2½	.40000	.20658	.26001	.19491
3	.33333	.17215	.21667	.16242
4	.25000	.12911	.16250	.12182
5	.20000	.10329	.13000	.09745
6	.16667	.08608	.10834	.08121
8	.12500	.06456	.08125	.06091
10	.10000	.05164	.06500	.04873
12	.08333	.04304	.05417	.04061
14	.07143	.03689	.04643	.03480
16	.06250	.03228	.04063	.03045

[1]Based on zero helix angle.

TABLE 146.—*Relation of best wire diameters and pitches*[1]*—wires for American National coarse, fine, hose-coupling, and pipe threads*

Best wire sizes	Threads per inch																												
	80	72	64	56	48	44	40	36	32	28	27	24	20	18	16	14	13	12	11½	11	10	9	8	7½	7	6	5	4½	4
Inch																													
0.00722	⊗	X	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	...	...	...	...	....	...	...	...	....	....
.00802	X	⊗	X	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	...	...	...	...	....	...	...	...	....	....
.00902	X	X	⊗	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	...	...	...	...	....	...	...	...	....	....
.01031	X	X	X	⊗	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	...	...	...	...	....	...	...	...	....	....
.01203	X	X	X	X	⊗	X	...	...	...	...	...	...	...	...	...	...	...	...	.....	...	...	...	...	....	...	...	...	....	....
.01312	...	X	X	X	X	⊗	X	...	...	...	...	...	...	...	...	...	...	...	.....	...	...	...	...	....	...	...	...	....	....
.01443	...	...	X	X	X	X	⊗	X	...	...	...	...	...	...	...	...	...	...	.....	...	...	...	...	....	...	...	...	....	....
.01604	...	...	...	X	X	X	X	⊗	X	...	...	...	...	...	...	...	...	...	.....	...	...	...	...	....	...	...	...	....	....
.01804	...	...	...	...	X	X	X	X	⊗	...	...	...	...	...	...	...	...	...	.....	...	...	...	...	....	...	...	...	....	....
.02062	...	...	...	...	X	X	X	X	X	⊗	X	...	...	...	...	...	...	...	.....	...	...	...	...	....	...	...	...	....	....
.02138	...	...	...	...	...	X	X	X	X	X	⊗	X	...	...	...	...	...	...	.....	...	...	...	...	....	...	...	...	....	....
.02406	...	...	...	...	...	...	X	X	X	X	X	⊗	...	...	...	...	...	...	.....	...	...	...	...	....	...	...	...	....	....
.02887	...	...	...	...	...	...	...	...	X	X	X	X	⊗	X	...	...	...	...	.....	...	...	...	...	....	...	...	...	....	....
.03208	...	...	...	...	...	...	...	...	...	X	X	X	X	⊗	X	...	...	...	.....	...	...	...	...	....	...	...	...	....	....
.03608	...	...	...	...	...	...	...	...	...	...	X	X	X	X	⊗	...	...	...	.....	...	...	...	...	....	...	...	...	....	....
.04124	...	...	...	...	...	...	...	...	...	...	...	X	X	X	X	⊗	X	...	.....	...	...	...	...	....	...	...	...	....	....
.04441	...	...	...	...	...	...	...	...	...	...	...	...	X	X	X	X	⊗	X	X	...	...	...	...	....	...	...	...	....	....
.04811	...	...	...	...	...	...	...	...	...	...	...	...	X	X	X	X	X	⊗	X	X	...	...	...	....	...	...	...	....	....
.05020	...	...	...	...	...	...	...	...	...	...	...	...	X	X	X	X	X	X	⊗	X	...	...	...	....	...	...	...	....	....
.05249	...	...	...	...	...	...	...	...	...	...	...	...	...	X	X	X	X	X	X	⊗	X	...	...	....	...	...	...	....	....
.05773	...	...	...	...	...	...	...	...	...	...	...	...	...	...	X	X	X	X	X	X	⊗	X	...	....	...	...	...	....	....
.06415	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	X	X	X	X	X	X	⊗	X	....	...	...	...	....	....
.07217	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	X	X	X	X	X	X	⊗	X	...	...	...	....	....
.07698	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	X	X	X	X	X	X	X	⊗	X	...	...	....	....
.08248	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	X	X	X	X	X	X	X	⊗	...	...	....	....
.09623	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	...	X	X	X	X	X	⊗	...	....	....
.11547	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	...	...	...	X	X	X	X	⊗	X	....
.12830	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	...	...	...	...	X	X	X	X	⊗	X
.14434	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	...	...	...	...	....	...	X	X	X	⊗

[1]The crosses (X) indicate those wire diameters which can be used for each pitch. An encircled cross (⊗) indicates the "best wire" diameter for that pitch which heads the column.

2. METHODS OF MEASURING AND USING WIRES

The computed value for the pitch diameter of a screw thread gage obtained from readings over wires will depend upon the accuracy of the measuring instrument used, the contact load, and the value of the diameter of the wires used in the computations. In order to measure the pitch diameter of a screw-thread gage to an accuracy of 0.0001 inch by means of wires, it is necessary to know the wire diameters to 0.00002 inch. If the diameters of the wires are known only to an accuracy of 0.0001 inch, an accuracy better than 0.0003 inch in the measurement of pitch diameter cannot be expected. Accordingly, it is necessary to use a measuring instrument which reads accurately to 0.00001 inch.

Variations in diameter around the wire should be determined by rotating the wire between a measuring contact and an anvil having the form of a V-groove cut on a cylinder. The V-groove may be the thread space in a hardened and well-finished thread plug gage. Variations in diameter along the wire should be determined by measuring between a flat contact and a cylindrical anvil.

A wire presses on the sides of a 60° thread with the pressure that is applied to the wire by the measuring instrument. This fact would indicate that the diameter of the wire should be determined by readings made on the wire over a hardened and lapped cylinder having a radius equal to the radius of curvature of the helical surface of the thread at the point of contact, using the load to be used in determining the pitch diameter of the gage. However, it is not practical to employ such a variety of cylinders as would be required, and it is recommended for standard practice that diameters of wires be measured between a flat contact and a 0.750-inch hardened and accurately ground and lapped steel cylinder with the load used in measuring the pitch diameter of the gage. The plane of the flat contact should be parallel to the contact element of the cylinder within 0.00001 inch.

To avoid a deformation of the material of the wires and gages it is necessary to limit the contact load, and for consistent results a standard practice as to contact load in making wire measurements of hardened screw thread gages is necessary. Such a standard practice is included in the specifications below, and in section III, p. 31. The use of different contact loads will cause a difference in the readings over the wires, and such errors can only be compensated by the use of a value for the diameter of the wires depending on the contact load used. The effect of variation in contact load in measuring threads of fine pitches is indicated by the difference in readings obtained with 2 and 5 pounds load on a 24-pitch thread plug gage. The reading over the wires with 5 pounds load was 0.00013 inch less than with 2 pounds load. The common shop practice of holding the wires down into the thread by means of elastic bands has a tendency to prevent the wires from adjusting themselves to the proper position in the thread grooves; thus a false measurement is obtained. In some cases it has also been the practice to support the gage being measured on two wires, which are in turn supported on a horizontal surface, and measuring from this surface to the top of a wire placed in a thread over the gage. If the gage is of large diameter, its weight causes a distortion of the wires and an inaccurate reading is obtained. For these reasons these practices should be avoided.

Measurements of a thread plug gage made in accordance with these instructions, with wires which conform to the following specifications, should be accurate to 0.0001 inch.

In the case of Acme threads the wire presses against the sides of the thread with a pressure of approximately twice that of the measuring instrument. This would indicate that the diameter of the wires should be measured against a hardened cylinder having a radius equal to the radius of curvature of the helical surface of the thread at the point of contact, using approximately twice the load to be used in making pitch diameter readings. As with 60° threads it is not practical to use such a variety of sizes, and it is recommended that the measurements of wire diameter be made between a flat contact and a 0.750-inch hardened and accurately finished steel cylinder. To limit the tendency of the wires to wedge in and deform the sides of an Acme thread, it is recommended that pitch diameter measurements on 8 threads per inch and finer be made at 1 pound. For coarser pitches and larger wires the deformation of wires and threads is less than for finer pitches. Furthermore, the coarser pitches are used on larger and heavier product, on which the pitch diameter tolerance is greater and a larger measuring load may be required to make satisfactory measurements. It is, therefore, recommended that for pitches coarser than 8, the pitch diameter be measured at 2½ pounds.

3. STANDARD SPECIFICATION FOR WIRES AND STANDARD PRACTICE IN MEASUREMENT OF WIRES

The following specifications represent present practice relative to thread measuring wires:

1. Composition.—The wires shall be accurately finished hardened steel cylinders of the maximum possible hardness without being brittle. The hardness shall not be less than that corresponding to a Knoop indentation number of 630. A wire of this hardness can be cut with a file only with difficulty. The surface shall not be rougher than the equivalent of one measuring 3 microinches root mean square deviation from a true cylindrical surface, as measured with the Profilometer or equivalent means.

2. Construction.—The working surface shall be at least 1 inch in length. The wire may be provided with a suitable means of suspension.

3. Container and Marking.—A suitable container shall be provided for each set of wires, and the pitch for which the wires are the best size and the diameter of the working part of the wires, as determined by measurements under standard conditions as specified below, shall be marked on the container.

4. Diameter of Wires.—One set of wires shall consist of three wires which shall have the same diameter within 0.00002 inch, and this common diameter shall be within 0.0001 inch of that corresponding to the best size for the pitch for which the wire is to be used. Wires shall be measured between a flat contact and a 0.750-inch hardened and accurately ground and lapped steel cylinder with contact loads as follows: Wires for 60° threads and pitches finer than 20 threads per inch, 1 pound; wires for pitches of 20 threads per inch and coarser, 2½ pounds; wires for 29° Acme threads, 2½ pounds. It is recommended that wires, which are to be used for the measurement of gears, splines, dovetails, and other surfaces where the contact of the wire is a line contact, be measured between flat, parallel measuring contacts under a 1-pound load.

5. Variations in Diameter.—Variations in diameter around the wire (roundness) shall not exceed 0.00002 inch, as determined by measuring between a measuring contact and a hardened and well-finished 60° V-groove cut on a cylinder. Variations in diameter along the wire (taper), over the half-inch interval at the center of its length, shall not exceed 0.00002 inch, as determined by measuring between a flat contact and a cylindrical contact.

Tests for compliance of thread-measuring wires with the above specifications are made by the National Bureau of Standards for a fee stated in Fee Schedule 292*i*.

4. GENERAL FORMULA FOR MEASUREMENT OF PITCH DIAMETER

The general formula for determining the pitch diameter of any thread whose sides are symmetrical with respect to a line drawn through the vertex and perpendicular to the axis of the thread, in which the slight effect of helix angle is taken into account, is

$$E = M + \frac{\cot a}{2n} - G\left(1 + \operatorname{cosec} a + \frac{S^2}{2}\cos a \cot a\right),$$

in which

E = pitch diameter
M = measurement over wires
a = one half included angle of thread
n = number of threads per inch
G = diameter of wires
S = tangent of the helix angle.

The value of S, the tangent of the helix angle, is given by the formula

$$S = \frac{L}{3.1416E} = \frac{1}{3.1416NE},$$

in which

L = lead
N = number of turns per inch
E = nominal pitch diameter, or an approximation of the measured pitch diameter.

When extremely large helix angles (approaching 20°) are encountered, such as occur in multiple threads of small diameter, the above formula is subject to correction, as it is an approximation. However, if this formula is applied consistently to the measurement of both threaded setting plugs for thread ring gages and of thread plug gages, no difficulty should result from its universal application.

5. MEASUREMENT OF PITCH DIAMETER OF AMERICAN NATIONAL STRAIGHT THREADS

For standard threads of American National form the term $\left(\frac{GS^2}{2}\cos a \cot a\right)$ is neglected, as its value is small, being in all cases less than 0.00015 inch for standard fastening screws when the best-size wire is used, and the above formula takes the simplified form

$$E = M + \frac{\cot a}{2n} - G(1 + \operatorname{cosec} a).$$

The practice is permissible provided that it is uniformly followed, and in order to maintain uniformity of practice, and thus avoid confusion, the National Bureau of Standards uses the latter formula except when the value of the term $\left(\frac{GS^2}{2}\cos a \cot a\right)$ exceeds 0.00015 inch, as in the case of multiple threads, or other threads having exceptionally large helix angles. For 60° threads this term exceeds 0.00015 when $VEV\sqrt{n}$ is less than 17.1.

For a 60° thread of correct angle and thread form the above formula simplifies to

$$E = M + \frac{0.86603}{n} - 3G.$$

For a given set of best-size wires

$$E = M - C$$

when

$$C = G(1 + \operatorname{cosec} a) - \frac{\cot a}{2n}.$$

The quantity C is a constant for a given thread angle, and, when the wires are used for measuring threads of the pitch and angle for which they are the best size, the pitch diameter is obtained by the simple operation of subtracting this constant from the measurement taken over the wires. In fact, when best-size wires are used, this constant is changed very little by a moderate variation or error in the angle of the thread. Consequently, the constants for the various sets of wires in use may be tabulated, thus saving a considerable amount of time in the inspection of gages. However, when wires of other than the best size are used, this constant changes appreciably with a variation in the angle of the thread.

It has been shown that, with the exception of coarse pitch screws, variation in angle from the basic value causes no appreciable change in the quantity C for the best-size wires. On the other hand, when a wire near the maximum or minimum allowable size is used, a considerable change occurs, and the values of the cotangent and cosecant of the actual measured half angle are to be used. It is apparent, therefore, that there is a great advantage in using wires very closely approximating the best size. For convenience in carrying out computations, the values of cot $a/2n$ for standard pitches are given in table 144, p. 225.

6. MEASUREMENT OF PITCH DIAMETER OF AMERICAN NATIONAL TAPER THREADS

The pitch diameter of a taper thread plug gage is measured in much the same manner as that of a straight thread gage, except that a definite position at which the measurement is to be made must be located. A point at a known distance L from the end of the gage is located by means of a combination of precision gage blocks and the cone point furnished as an accessory with these blocks, as shown in figure 38 at A. The gage is set vertically on a surface plate, the cone point is placed with its axis horizontal at the desired height, and the plug is turned until the point fits accurately into the thread. The position of this point is marked by placing a bit of prussion blue or wax immediately above it. Measurement is made over the wires in the usual manner, but care must be taken that the measuring contacts touch all three wires, since the line of measurement is not perpendicular to the axis of the screw when there is proper contact. (See fig. 38.) On account of this inclination, the measured distance between the axes of the wires must be multiplied by the secant of the half angle of the taper of the thread. The formula for the pitch diameter of any taper thread plug gage, the threads of which are symmetrical with respect to a line perpendicular to the axis, then has the form[1]

$$E = (M-G)\ \sec\beta + \frac{\cot a}{2n} \cdot G\ \operatorname{cosec} a,$$

in which

E = pitch diameter
M = measurement over wires
β = half angle of taper of thread
n = number of threads per inch = $1/p$
a = half angle of thread
G = diameter of wires.

Thus the pitch diameter of an American National standard pipe-thread gage having correct angle (60°) and taper ($\frac{3}{4}$ inch per foot) is then given by the formula:

$$E = 1.00049\,(M-G) + 0.86603\ p - 2G.$$

The pitch diameter at any other point along the thread, as at the gaging notch, is obtained by multiplying the distance parallel to the axis of the thread, between this point and the point at which the measurement was taken, by the taper per inch, then adding the product to or subtracting it from the measured pitch diameter according to the direction in which the second point is located with respect to the first.

---

[1] See footnote 19, p. 117. In the above formula for the value of E, the term $\frac{\cot a}{2n}$ is an approximation for the value of H. The exact value of H is used when the value of the term $\frac{\tan^2\beta \tan a}{2n}$ exceeds 0.00004 inch, which ordinarily occurs only on special taper threads of coarse pitch or steep taper. The complete formula is

$$E = (M - G)\ \sec\beta + \frac{\cot a - \tan^2\beta \tan a}{2n} - G\,(\operatorname{cosec} a + \frac{S^2}{2} \cos a \cot a).$$

This formula gives a value of E which is 0.00005 inch smaller than that given by the simplified formula for the $2\frac{1}{2}$-8 American National taper pipe thread, the worst case in this thread series.

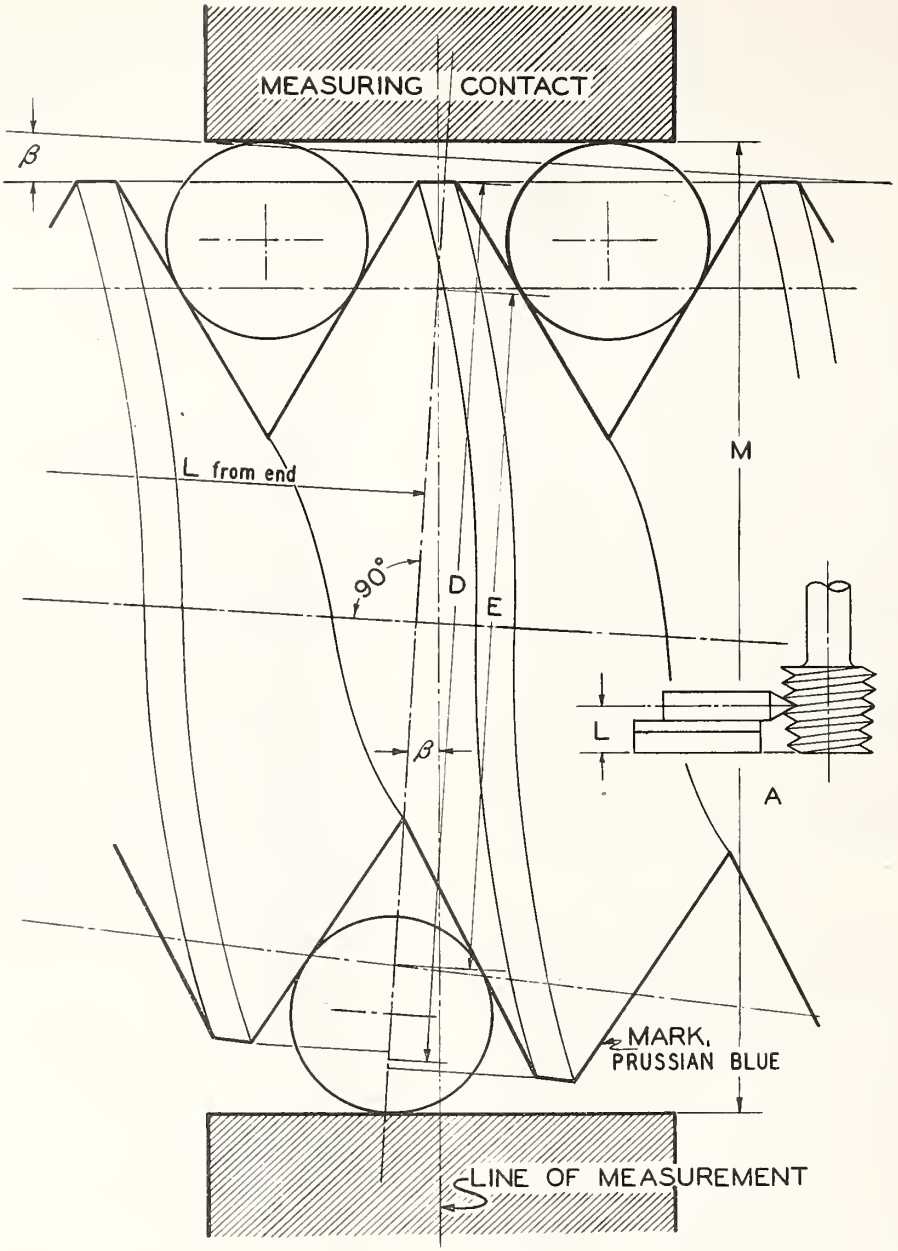


FIGURE 38.— *Measurement of pitch diameter of taper thread gages by the 3-wire method.*

Another method, illustrated in figure 39, has a theoretical advantage over the first method in that it is independent of the taper of the thread, and, therefore, requires less computation; or if the taper is not measured, but assumed to be correct, it is more accurate. The axis of the gage and the line of measurement are constrained perpendicular to each other. A single wire is inserted in the thread at the point located as in the previous method, and one other wire is placed in the upper thread on the opposite side. A measurement is taken over the two wires; the second wire is then moved to the thread immediately below and a second reading is taken. The mean of these two readings is substituted in the formula

$$E = M + \frac{0.86603}{n} - 3G.$$

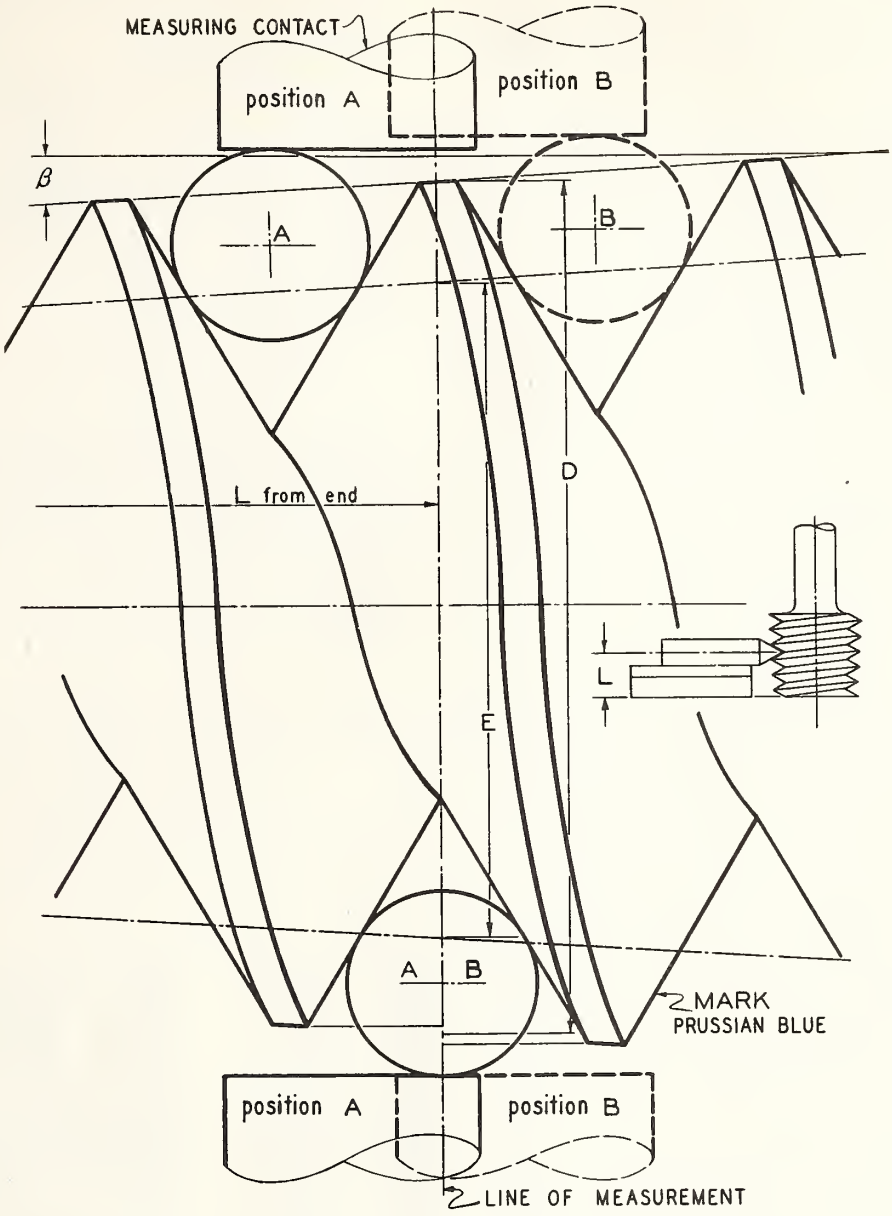


FIGURE 39.—*Measurement of pitch diameter of taper thread gages by the 2-wire method.*

7. MEASUREMENT OF PITCH DIAMETER OF THREAD RING GAGES

The application of direct methods of measurement to determine the pitch diameter of thread ring gages presents serious difficulties, particularly in securing proper contact load when a high degree of precision is required. The usual practice is to fit the ring gage to a threaded setting plug. When the thread ring gage is of correct lead, angle, and thread form, within close limits, this method is satisfactory and represents standard American practice. It is the only method available for small sizes of threads. For the larger sizes, various more or less satisfactory methods have been devised, but none of these have found wide application.

8. WIRE METHODS OF MEASUREMENT OF ACME THREAD PLUG GAGES

For Acme (29°) threads, either the pitch diameter or thread thickness in relation to basic major diameter (that is, the thread thickness at the nominal pitch diameter) may be used to determine the quality of fit. In both cases the three-wire method of measurement is used. Because the angle of the thread is small, and its cotangent large, it is

always necessary to take the helix angle into account in deriving values of pitch diameter or thread thickness. The general formula for pitch diameter, the same as for 60° threads, is

$$E = M + \frac{\cot a}{2n} - G\ (1 + \text{cosec } a + \frac{S^2}{2} \cos a \cot a).$$

The symbols are as given on p. 228. For a 29° thread of correct angle and thread form, the formula reduces to

$$E = M + \frac{1.93336}{n} - G\ (4.99393 + 1.87178\ S^2).$$

For standard sizes and pitches of Acme threads the computation is simplified further by means of table 147, if the best size wire is used, thus

$$E = M - \text{col. } 7,$$

or if E differs appreciably from the basic value given in column 3,

$$E = M - \text{col. } 7 - 100\ (\text{col. } 3 - E_1) \times \text{col. } 8,$$

where

$$E_1 = M - \text{col. } 7.$$

If the measured wire diameter, G', differs slightly (not more than 0.0003 in.) from the best size, G, shown in column 4,

$$E = M - \text{col. } 7 - 5(G' - G) - 100\ (\text{col. } 3 - E_1) \times \text{col. } 8.$$

Although the correction derived from column 8 may seldom be significant in amount for standard sizes and pitches of Acme threads, the procedure indicated will serve as a model of a short-cut method for the correct measurement of multiple Acme threads, with which such correction is important, as shown below.

If the general formula

$$E = M + \frac{\cot a}{2n} - G(1 + \text{cosec } a + \frac{S^2}{2} \cos a \cot a)$$

is used in the measurement of a multiple threaded screw having a large helix angle, the use of the nominal pitch diameter in the formula for the tangent of the helix angle, $S = 1/3.14159NE$, may not be sufficiently accurate. If there is an appreciable difference between the nominal and measured pitch diameter, it is necessary to substitute the computed values of pitch diameter in the formula and derive a new value for pitch diameter. In cases of

TABLE 147.—*Values for wire measurements of standard Acme threads*

Sizes	Threads per inch	Basic pitch diameter	Best wire size, G	$\frac{\cot a}{2n}$	$G(1 + \text{cosec } a + \frac{S^2}{2} \cos a \cot a)$	Col. 6 minus col. 5[1]	Change in cols. 6 and 7 per 0.01 in. change in pitch diameter (col. 3)
1	2	3	4	5	6	7	8
Inches		*Inches*	*Inch*		*Inches*	*Inch*	*Inch*
¼	16	0.2187	0.03228	0.120835	0.161704	0.040869	0.000049
5/16	14	.2768	.03689	.138097	.184692	.046595	.000036
⅜	12	.3333	.04304	.161113	.214449	.054336	.000032
7/16	12	.3958	.04304	.161113	.215301	.054188	.000019
½	10	.4500	.05164	.193336	.285370	.065034	.000022
⅝	8	.5625	.06456	.241670	.323013	.081343	.000022
¾	6	.6667	.08608	.322226	.430898	.108672	.000031
⅞	6	.7917	.08608	.322226	.430601	.108375	.000019
1	5	.9000	.10329	.386671	.516790	.130119	.000022
1⅛	5	1.0250	.10329	.386671	.516569	.129898	.000015
1¼	5	1.1500	.10329	.386671	.516415	.129744	.000010
1⅜	4	1.2500	.12911	.483339	.645746	.162406	.000016
1½	4	1.3750	.12911	.483339	.645576	.162236	.000012
1¾	4	1.6250	.12911	.483339	.645346	.162007	.000007
2	4	1.8750	.12911	.483339	.645202	.161862	.000005
2¼	3	2.0833	.17215	.644452	.860541	.216089	.000008
2½	3	2.2333	.17215	.644452	.860432	.215980	.000007
2¾	3	2.5833	.17215	.644452	.860248	.215796	.000004
3	2	2.7500	.25822	.966678	1.291151	.324173	.000012
4	2	3.7500	.25822	.966678	1.290403	.323725	.000005
5	2	4.7500	.25822	.966678	1.290075	.323397	.000002

[1]Given to 6 decimal places for purposes of computation. After subtracting from M the final result should be rounded to 4 places.

extremely large helix angle it may be necessary to make successive substitutions before a satisfactory agreement between the assumed and computed pitch diameter is obtained. Except where the helix angle is exceptionally large, a difference of 0.001 inch between assumed and computed pitch diameter can be tolerated.

Where a number of threads of the same nominal size are to be measured, the development and use of a table similar to table 147 will simplify the procedure.

Another method of determining S is to measure the angle, $2s$, between the planes, perpendicular to the thread axis, passing through the axes of the wires placed in the thread on opposite sides. In case of threads of small diameter, it is possible to do this in a projection comparator.

To determine the thread thickness at the nominal pitch diameter, readings over three wires are made in the same manner as for pitch diameter. The thread thickness is given by the following formula

$$t = p - \tan a \left[D - 2B - M + G\left(1 + \operatorname{cosec} a + \frac{S^2}{2} \cos a \cot a\right)\right],$$

in which

D = basic major diameter of screw
M = measurement over wires
G = diameter of wires
a = half angle of thread
S = tangent of helix angle at pitch line
p = pitch
B = depth at which thread thickness is measured
t = thread thickness at depth B.

On Acme screw threads

$$B = p/4$$

and the thread angle being 29°, the above formula reduces to—

$$t = 1.12931p + 0.25862(M - D) - G(1.29152 + 0.48407S^2).$$

The same formula applies to taps for Acme threads, although the major diameter is larger than basic, since the formula is based on the basic major diameter.

APPENDIX 3. CONTROL OF ACCURACY OF THREAD ELEMENTS IN THE PRODUCTION OF THREADED PRODUCT

1. INTRODUCTION

In order to maintain the dimensions of threaded product within the limiting sizes specified, it is essential that the tools used and the processes applied be suitable for the particular requirements. An analysis of the various factors controlling the accuracy of the individual thread elements is here presented. In this analysis, the fundamental factors controlling the accuracy of the elements of a screw thread are stated, and are followed by a brief discussion of the relationship of these factors to each of the prevailing commercial methods of producing screw threads. It is recognized, however, that certain varying factors are involved, such as lubrication, method of holding the work or tool, sharpness of cutting edges, etc., so that it is not always possible to predetermine the exact sizes of the tools required to accomplish the desired results.

Screw threads are usually produced either by cutting or rolling. Five general methods of cutting, two of rolling, and two of finishing screw threads are in common use.

Screws or external threads are commonly produced by lathe tools, solid or adjustable dies, adjustable or opening die heads with removable chasers, single or multiple thread milling cutters, and roller dies.

Of these, the dies, die-head chasers, and hobs are all multiple toothed, cutting in several thread spaces simultaneously, and finishing the operation at one pass. Lathe tools are ordinarily single-pointed and operate in a single thread, which is finished by repeated passes; but multiple-pointed chasers for use as lathe tools are sometimes made.

All rolled threads and many cut threads are produced with dies, chasers, or hobs made with master tools, such as hobs, taps, or milling cutters. These master tools are frequently made with forming cutters or other tools, but the primary tool is always made with a single-point tool. Angle and pitch errors tend to accumulate in a series of master tools and must be carefully considered in the design and use of this single-point tool.

Internal threads or tapped holes are commonly produced by means of taps and sometimes by lathe tools. Much progress has been made in the standardization of the dimensions and tolerances for cut and ground thread taps.[2]

2. FUNDAMENTAL FACTORS

The accuracy of the individual elements of a thread is controlled mainly as follows:

Angle by the angle between, and contour of the cutting edges of the tool used for cutting, or of the sides of the grooves of the die used for rolling.

Lead by the rate of the longitudinal motion of the tool with respect to the rate of revolution of the part to be threaded.

Major diameter of external thread by the outside diameter of the stock, or by the forming tool.

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[2] See American Standard ASA B5.4-1939, "Taps: Cut and Ground Threads" of the American Standards Association, published by the ASME, 29 West 39th Street, New York 18, N. Y. ($1.25).

Minor diameter of internal thread by the diameter of the hole in the work before threading. In the case of a drilled hole, this depends on the diameter and accuracy of grinding of the tap drill used, and the use of a reamer may be necessary.

Pitch diameter by the radial setting of the forming surface of the tool.

Thread form by the form and position of the tool, and the conditions under which it is used.

(*a*) CONTROL OF TOOTH OUTLINES.—Inspection of the angle and profile of the thread-forming tool is essential to control the accuracy of the thread produced. All threading tools, whether for use in a lathe, die head, thread miller, or roller, and whether single or multiple pointed, must produce the proper tooth profile on an axial section of the work. The final test of accuracy in any threading tool is its ability to produce a thread of the proper axial section as defined in the body of this handbook.

Most cutting tools for standard threads have their cutting edges in the axial plane of the work, so that the shape of those edges tends to reproduce itself on the screw thread. In forming and inspecting the cutting edges of these tools, their forms may be directly compared with standard outlines. This can be done by means of accurately formed templets, carefully applied under the microscope. A more satisfactory and practical way is to draw the desired outline on a chart to a magnification of 30 to 100 times, and then project on this chart the image of the cutting tool under inspection magnified to the corresponding degree. By this means the tool shape may be quickly compared with the standard shape to a satisfactory degree of accuracy. Care must be taken to use a lens system free from distortion. Optical projection machines and comparators are available for this work in commercial designs. (See "Thread comparators," p. 239.)

(*b*) CONTROL OF LEAD ERRORS.—The sources of lead errors require special consideration, and for this purpose the methods of producing screw threads may be considered under two headings, namely, those in which relative longitudinal motion of the tool and product is controlled by means of a lead screw and those in which the tool is self-leading.

(1) *Tool controlled by lead screw.*—In cutting a thread on a lathe or other machine embodying a lead screw, using a single point cutting tool or single milling cutter, progressive lead errors are caused by (1) a progressive lead error in the lead screw; (2) lack of parallelism of the motion of the cutting tool, the axis of the lead screw, and the axis of the part to be threaded; and (3) incorrect ratio of the rate of revolution of the spindle to that of the lead screw, because of an incorrect or approximate combination of gears.

Local lead errors are caused by (1) local lead errors in the lead screw; (2) lost motion in the action of the lead screw or connecting mechanism; (3) varying frictional resistance in the mechanism; (4) when a live center is used, irregular play of its spindle in the bearings; and (5) variations in the amount of metal removed by the cutting tool.

Periodic lead errors are caused by (1) periodic lead errors in the lead screw; (2) eccentricity of motion of the lead screw; (3) thrust bearings of spindle or lead screw running out of true; (4) variations in the spacing of gear teeth, or eccentric gears or mountings; (5) when a live center is used, eccentricity of motion of its spindle; and (6) periodic variations in the amount of metal removed, because of lack of uniformity of the material in diameter, straightness, or physical properties.

When a multiple-toothed threading tool is controlled by a lead screw, variations from correct spacing of the teeth of the tool are superimposed on the lead errors resulting from any of the above causes in that portion of the thread not passed over by every tooth of the tool. In the portion of the thread completely passed over by the tool, the effect of the difference in lead between the tool and lead screw is to produce a thin thread.

The simplest method of inspecting a machine tool to determine whether it will cut a screw thread within satisfactory limits is to cut carefully a sample screw on the machine and measure the lead errors of the screw. The obvious remedy for errors from such sources is the careful inspection of the various elements of the machine, and correction of the errors thus located, either by improving the design or by carefully refinishing or remaking the parts to a greater degree of accuracy.

(2) *Self-leading threading tool.*—When a thread is cut by means of a tap or die, which, as ordinarily used, are self-leading and not controlled by a lead screw, lead errors may occur as the result of (1) incorrect lead of the tap or die; (2) too much or too little relief at the throat of the die or on the chamfer at the end of the tap; (3) the setting of an adjustable die or tap chaser to cut a thread considerable larger or smaller than that for which the tool was intended—that is, to cut a helix angle considerably different from the helix angle of the chaser; (4) excessive resistance to longitudinal motion; (5) improper alinement of the axis of the tap or die with that of the work, etc.; and (6) excessive angle relief.

The control of accuracy of the lead of the tap or of the chasers in the die is the most difficult of these sources of error, and indeed presents serious difficulties. There is, first, the difficulty of cutting a tap or chaser which is free from lead errors resulting from any of the causes outlined above; and second, the distortion which the steel composing the tap or die undergoes in hardening.

When especially accurate work is required, as in producing threaded product to class 4 fit specifications, it is very desirable, and sometimes necessary, that the feed of the tap or die be controlled by means of lead screw.

In the inspection of such thread-forming tools practically the same means and methods can be applied as in the measurement of screw-thread gages. For checking the lead, indicating gages or some of the usual lead-measuring devices for screw-thread gages may be used. To measure the lead of a die chaser, the chaser must be held in a fixture in such a

position that the direction of measurement corresponds to the direction of longitudinal motion of the chaser threads when cutting a thread.

3. CUTTING OF SCREW THREADS

(*a*) Single-Point Tool.—A screw thread may be produced by traversing a single-point threading tool—shaped to correspond to the shape of the thread space in an axial plane, and so placed as to cut an angle, equal to the angle of the top surface of the tool, in correct relation to the axis of the thread—along the revolving part to be threaded at such a rate as to produce a thread of the desired lead. This is the common method of cutting screws in an engine lathe, a lead screw driven by gearing being the usual means for imparting to the tool the longitudinal motion at the desired rate. This method is used commercially only when special conditions make it necessary, as when the thread to be cut is not standard, or when it is not practicable to apply other methods.

Various forms of single-point cutting tools for cutting threads of American National form are illustrated in figure 40 at *A*, *B*, *C*, and *D*. The circular tool shown at *C* has the advantage that it can be reground indefinitely without destroying its correct form. The diagram at *D* shows the method for calculating the angle *X* of the cutting tool, having a clearance angle *V*, in a plane perpendicular to the edge *MN*; and the formula for determining the clearance angle *V*, of a tool for cutting a thread of helix angle *s*, is also given. Such tools usually consist of hardened tool steel, ground to the correct form after hardening; special alloys such as "stellite" and "carboloy" are also used for this purpose.

(*b*) Thread Chaser.—A screw thread may be produced by successively traversing a multiple-point thread tool, known as a chaser, along the part to be threaded, each tooth following in the thread in the same manner as a single-point thread tool. Two forms of chasers are shown in figure 40 at *E* and *F*, the one at *F* being especially suitable for cutting fine threads. Chasers are well adapted to roughing out threads, as they cut rapidly, and may be used for finishing threads accurately if the teeth are ground after hardening.

(*c*) Tap or Die.[3]—A screw thread may be produced by using a tap for internal threads or a die for external threads. These tools occur in considerable variety in their commercial forms, but consist essentially of a number of multiple-point cutters or chasers, usually four, arranged circumferentially. They may be either solid or adjustable, and collapsible or self-opening, respectively, for withdrawing quickly from the work after threading. By their use a thread is generally finished by one passage of the tool, although a second or finishing cut is sometimes made to secure greater accuracy. Dies[4] are applied, in general, to threading screws, bolts, and studs; and taps to nuts or other internal threads within the usual range of sizes. They are also applied to the threading of pipe and pipe fittings. The rapidity with which threading operations may be performed by the use of taps and dies, within the limits of accuracy suitable for a large percentage of commercial work, makes them most efficient and widely used threading tools. It is only in cutting large sizes or coarse pitches, or where a high degree of accuracy is desired, that their use may be less economical than other means of cutting threads.

Aside from lead errors, which have been previously considered, the accuracy of the thread produced depends on the form of the cutting teeth, character of the cutting edges, clearance or relief for cutting edges, construction of the tool, and the conditions under which it is used.

A defect which commonly occurs in general purpose bolts and nuts is that the thread angle of the nut is larger than nominal by several degrees. In such production bent-shank tapper taps are commonly used. The enlarged thread angle may be the result of the fact that the weight of the nuts, which are above the nut being tapped, resists the self-leading of the tap, and also the fact that the axis of the tap is not rigidly constrained to coincide with the axis of the hole in the nut to be tapped. An attempt should be made to correct this condition by using taps which have the thread angle smaller than nominal by an amount equal to the prevalent average angle error.

(*d*) Milling Cutter.—A screw thread may be produced by feeding in to the depth of the thread and then traversing a rapidly revolving single milling cutter along the slower revolving part to be threaded at such a rate as to produce a thread of the desired lead; the profile of the cutting edges of the cutter conforming approximately to the shape of the thread groove in an axial plane, and the axis of the cutter being set at an angle to the axis of the thread, in a plane parallel to the axis of the thread, equal to the mean helix angle of the thread cut. The single-cutter method of thread milling is especially applicable to the cutting of large threads of coarse pitch, multiple threads, and the heavier classes of work. When the amount of metal to be removed is large, as compared with the size of the screw, this method is especially suitable because the torsional strain is much smaller than

[3] A considerable amount of valuable information regarding accurate cutting of threads with taps and dies is available in catalogs and handbooks of tap and die manufacturers.

[4] Simplified lists of sizes and varieties, for threads of American National form, of die-head chasers for self-opening and adjustable die heads, as adopted at general conferences of representative manufacturers, distributors, and users, are promulgated in United States Department of Commerce Simplified Practice Recommendation R51-29.

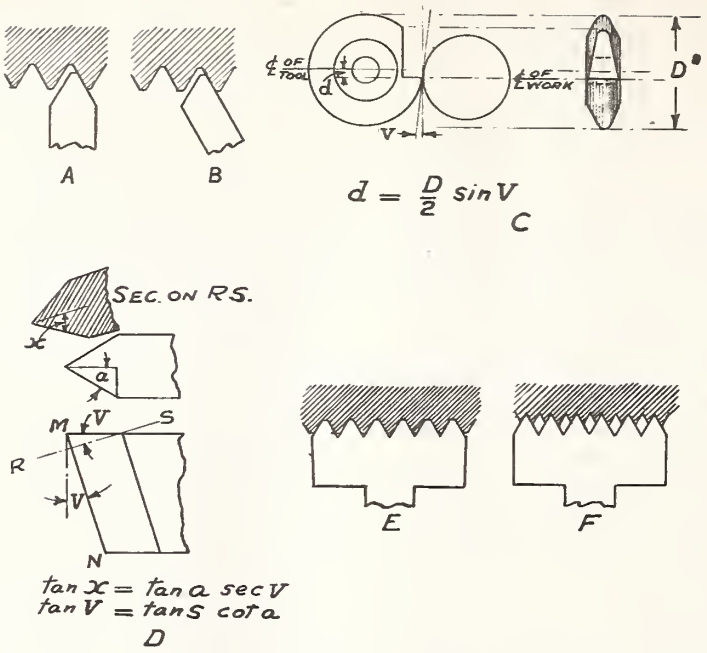

FIGURE 40.—*Single point and multiple point thread-cutting tools.*

that produced by a die, and consequently the accuracy of the screw produced is greater.[5]

(*e*) MULTIPLE THREAD-MILLING CUTTER.—A screw thread may be produced by feeding in to the depth of the thread, and then traversing a rapidly revolving multiple milling cutter or thread hob, somewhat longer than the length of the thread to be cut—which consists of annular rows of teeth, whose centers lie in planes perpendicular to the axis of the cutter (in effect a series of single cutters formed into one solid piece), and the axis of which is parallel to the axis of the thread—along the slowly revolving part to be threaded slightly more than either one or two complete revolutions of the work, at a rate per revolution of the work equal to the pitch of the thread. The multiple-cutter method of thread milling is used largely for cutting comparatively short threads, usually of fine or medium pitches, when smoothness or a considerable degree of accuracy is desired, or when the thread must maintain a fixed relation with a point or surface on the work.

The error introduced in the form of thread produced by cutter teeth having the same form as that of the intended form of thread, as the result of the axes of cutter and thread being parallel, is usually not serious except when the helix angle is large.[6]

4. ROLLING OF SCREW THREADS

The second general process for forming screw threads—namely, that of rolling is a hot- or cold-forging process. It may be defined as an impression or displacement method whereby the threads are formed by means of a die or roll having threads or ridges, which are forced into the material to be threaded, and, by displacing it, produce a thread of the required form and pitch. In this process no material is removed, but the metal is displaced from the thread space and forced up on each side above the original surface of the piece to be threaded. Thus, the major diameter of a V-shaped 60° thread so produced is found in practice to be greater than the original diameter of the blank by an amount varying from 65 percent of the single depth of thread for small screws to 85 percent for large screws. An approximate formula, based on geometrical considerations only, for the diameter of a blank to

[5] For refinements in connection with the determination of the profile of cutting edge of a thread milling cutter, see The Milling of Screw Threads and Other Problems in the Theory of Screw Threads, by H. H. Jeffcott. Proceedings of the Institution of Mechanical Engineers, 1922-I, pp. 515-528, and discussion pp. 529-562; or Engineering (London), vol. 113, Apr. 7, 1922, pp. 441-442, and discussion pp. 412-414.

[6] For formulas which may be applied in such cases to determine and plot the exact contour of the cutting edges to produce, as nearly as possible, the thread form required, see Side-Cutting of Thread Milling Hobs, by Earle Buckingham, Transactions of the American Society of Mechanical Engineers, vol. 42, 1920, pp. 569-593; The Design of Hobs for Taper-threaded Joints, by Earle Buckingham, American Machinist, vol. 69, Nov. 15 and 22, 1928, pp. 759-763, 801-803; also the reference cited in footnote 5, for thread milling cutter profile.

be threaded to American National form is as follows:

$$D_1 = \sqrt{D^2 - 1.3Dp + 0.63p^2},$$

in which

D_1 = diameter of blank
D = major diameter of thread
p = pitch of thread.

In case the thread required must be accurate within close limits, the exact value of D_1 necessary in any given case must be determined experimentally, as its value is affected by the physical properties of the material.[7]

The thread-rolling process is the most rapid and economical method of forming screw threads in quantity production, when the part to be threaded is of such form as to permit its use. It is used only for external threads and is not regarded as being feasible for internal threads, since the area of contact of the roll in an internal thread is relatively much larger than on an external thread, and in order to displace the metal a very heavy pressure is required. It is difficult to support the work with the necessary rigidity to withstand the heavy pressure, and to provide a bearing for the roll which will withstand the stress.

Screw threads may be rolled by either of two methods, as follows:

(*a*) Threading Roll.—By forcing a cylindrical disk or roll, having a threaded periphery and being free to rotate on the pin or bolt on which it is mounted, against the piece to be threaded while the latter is revolving. The cylindrical roll is used when the work is in an automatic screw machine or turret lathe, and it is impossible to cut the thread required by means of a thread-cutting die, or when an additional operation would be necessary before cutting the thread. The thread on the roll corresponds in pitch, and approximately in form, to the thread to be rolled. The roll may be presented to the work in either a tangential direction as shown at *A*, figure 41, or radially as shown at *B*; a satisfactory thread is formed in either case.

(*b*) Thread-Rolling Dies.— By rolling the blank between dies, which may be either flat or cylindrical in form, when performed by machines designed exclusively for this work. When flat dies are used, as shown in figure 41 at *C*, one die, *M*, remains stationary and the other die, *N*, which is parallel or nearly parallel to *M*, has a reciprocating movement. The faces of the dies have parallel milled or planed grooves of approximately the same form as that of the required thread, which are set at an angle to the line of motion of the blank equal to the helix angle of the thread to be produced. The angles of the grooves and ridges in a plane perpendicular to the direction of the grooves are given by the formula

$$\text{Tan } a_1 = \tan a \cos s,$$

in which

a_1 = half angle of ridge of die
a = half angle of thread to be rolled
s = helix angle of thread.

The spacing of the ridges is determined by the formula

$$p_1 = p \cos s,$$

in which

p_1 = spacing of ridges of die
p = pitch of thread to be rolled
s = helix angle of thread.

The blank is inserted at one end of the stationary die, and rolls between the die faces until it

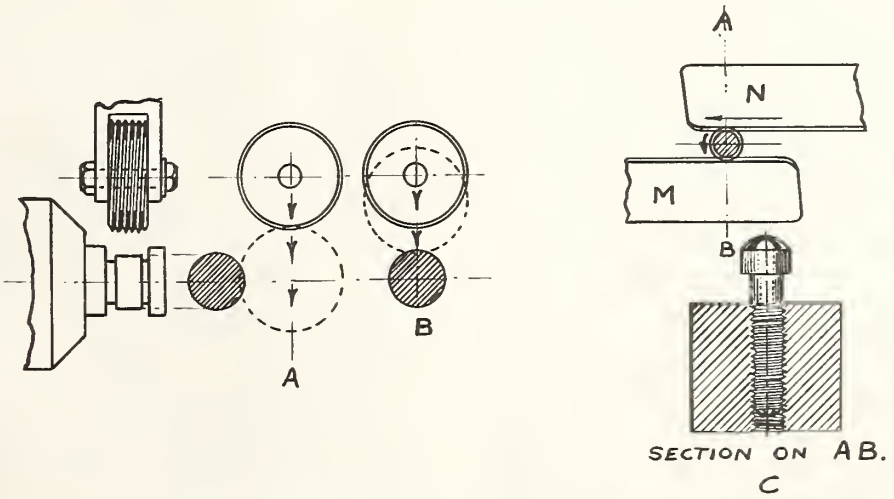

Figure 41.—*Methods of rolling screw threads.*

[7] This formula is derived in Size of Stock for Bolts Having Rolled Threads, by F. Webster, American Machinist, vol. 30, Oct. 31, 1907, p. 630.

is ejected at the other, the thread being formed in one passage of the blank. When cylindrical dies are used, one of the dies, which is a complete cylinder, revolves continuously in one direction and the other is a stationary cylindrical segment. This method is used extensively for threading almost all forms of small and medium sizes of screws and bolts, when required in sufficiently large quantities to warrant the use of a thread-rolling machine.[8]

5. FINISHING OF SCREW THREADS

On account of the difficulty of producing an accurately finished thread by means of a cutting tool, in ordinary gage-making practice the thread is ground, lapped, or ground and lapped, in order to finish all elements of the thread to correct dimensions. The process of grinding is applied to hardened screws only, and is intended to correct any errors present as the result of distortion in the hardening process, as well as those resulting from the cutting operation. Threads are also sometimes "ground from the solid," that is, the entire thread is produced by grinding. Lapping is usually applied to hardened screw threads, and may be either substituted for grinding, or performed after grinding to remove the marks left by the grinding wheel and to produce a smooth and highly finished surface. These processes are used largely in the production of screw-thread gages.

(*a*) Grinding.—The grinding of a thread is similar to the process of milling a thread by the single-cutter method. The profile of the periphery of the grinding wheel is "dressed" by means of a diamond to conform to the shape of the thread-groove in an axial plane, with the axis of the wheel set at an angle to the axis of the thread, in a plane parallel to the axis of the thread, equal to the helix angle. In order to produce a thread having straight sides and correct angle, the periphery of the wheel should be dressed to the required angle after the wheel has been set to the helix angle, in the plane containing the axis of the thread and the center of the wheel. The same considerations as to the exact profile of the periphery of the grinding wheel, to produce a thread of exactly correct form, apply as for the tooth profile of a single milling cutter set at the helix angle of the thread. The principal differences between the thread milling and grinding processes are that a large diameter of grinding wheel is desirable, and one or more light cuts are taken, whereas, a small diameter of milling cutter is desirable and a single heavy cut is taken.

(*b*) Lapping.—The lapping of a screw thread may be defined as a process of abrasion by successively traversing the thread, as it revolves, with a so-called lap, which consists of an engaging screw thread of softer material, usually fine-grained cast iron, brass, or cold-rolled steel, in which very fine abrasive material is embedded in the thread surface. For removing considerable material, the laps are charged with coarser abrasive, and for imparting fine finish, a finer abrasive; in either case the abrasive used is very fine, and the lap is thoroughly lubricated. A number of laps may be necessary to finish either an internal or external thread to the required form and dimensions, as illustrated in figure 42.

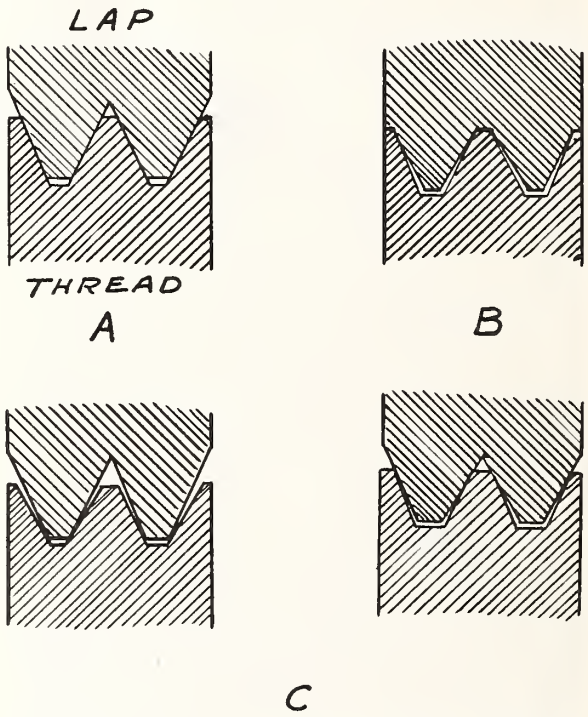

Figure 42.—*Thread form of laps for lapping screw threads.*

6. GAGING PRACTICES AND TYPES OF GAGES

The production of accurate parts is primarily a matter of constant vigilance and of training of workmen. The smaller the tolerances which are to be maintained, the more complete the inspection or gaging system must be. In order to secure satisfactory results, the manufacturing tools provided must be sufficiently accurate, and the manufacturing methods must be sufficiently reliable to produce the required results. After tools and methods of proved reliability are provided, it is necessary to watch the wear on the tools or changes in their setup to insure that the required conditions are maintained. This is accomplished by periodical tests of the tools and by periodical gaging of the product.

There are presented here some gaging practices applied to screw threads which are supplementary to those outlined in sections III and VI.

The most difficult element of a screw thread to gage is the lead. Lead-testing devices for checking tools and gages are available, but, in general,

[8] The principles involved in determining the spacing and angle of ridges of flat dies, and position of the dies, are considered in Principles of Thread Rolling and the Setting of Dies, by J. F. Springer, American Machinist, vol. 33, Apr. 21, 1910, pp. 739-741.

their operation is too slow for use as production inspection equipment. In addition, the lead is the most important element of a screw thread as regards the nature of the contact between the surfaces of the mating parts. Furthermore, the effect of an error in lead is almost double that of an equal error in diameter as regards interchangeability. For exacting threaded work, if the method of inspection of the product does not effectively detect lead errors, the tools used must be carefully inspected for lead. In order to reduce the possibilities of disagreement to a minimum, the manufacturer should strive to produce parts well within the specified limits rather than close to the limiting sizes.

(*a*) Thread Micrometers.—Thread micrometers are sometimes used to measure the pitch diameter of taps and screws. Thread micrometers should be calibrated periodically against a master gage, to avoid errors due to wear on the anvils of the instrument. As thread micrometers give no indication of lead and angle errors, the results of tests made with thread micrometers alone cannot be taken as conclusive, and a "go" gage should always be used as a supplementary test. Thread micrometers are very effective means of checking against the change in set-up due to wear on tools, etc.

(*b*) Thread Comparators.—A development in the art of measuring threaded parts is the optical thread comparator, which embodies the principle of gaging in an optical projection system. In addition to giving a rapid indication of whether or not the elements of the screw thread lie within the limiting dimensions specified, such instruments furnish more detailed information as to the errors in screw threads than is usually obtained by means of mechanical gages, particularly as to irregularities in thread form, lead, and diameter. These instruments can be adapted to measure taps and other threading tools.

The available forms of projection comparators differ somewhat in design and principle, but each consists primarily of a source of parallel light, such as a mercury arc or concentrated filament lamp with condensing lens system, a projection lens system, a screen upon which the magnified shadow image of the work is projected, and a device for holding the work in position in front of the projection lenses. Measurements are made of the projected shadow image, or there may be a tolerance chart on the screen on which two outlines of the correct thread form at the magnification used are spaced one above the other a distance equal to the tolerance multiplied by the magnification. The chart and gage holder are adjusted to position by projecting the shadow image of a setting gage and adjusting to bring the outline of the shadow image and certain lines of the chart into coincidence, after which the system may be used as a gaging device.

The above types of optical thread comparators are applicable to external threads. Two types of optical thread comparators for internal threads have been developed by the National Bureau of Standards, one known as an "optical coincidence thread gage", and the other as a "stereoscopic thread gage."[9]

(*c*) Indicating Gages.—An indicating thread gage has movable contact points, which are set to a setting gage, and is intended to give an exact indication of the variations of the dimensions of a screw thread within the specified limits, rather than to show merely that the thread is within, or outside of, the specified limits, as is the case with limit gages. In such gages the movable contact points actuate a multiplying lever system, or other means for magnifying their motion, and the amount of the motion is registered on a graduated dial or scale. Indicating gages are made according to a variety of designs, some to indicate progressive lead error only, some to indicate pitch diameter only, some to indicate both separately but on the same gage, others to indicate the major and minor diameters as well, and still others to indicate the apparent size. They have been applied almost exclusively to external threads. Those which indicate the apparent size may be considered as most nearly fulfilling the requirements of a gaging system. However, those indicating lead errors are very useful in controlling lead errors in threading tools and screw-thread products. Also certain types can be used to indicate the variation in roundness on pitch or major diameters.

(*d*) Inspection of Tapped Holes.—At the present time the most practical means of gaging threaded holes or nuts is by the use of thread plug gages. When the product is to be within specified limits, "go" and "not go" gages are required. The use of such gages gives some information as to lead and angle errors as well as pitch diameter errors. A correct "go" plug gage will reject any parts which fall below the minimum dimensions specified.

One practice of inspecting tapped holes is first to inspect the tap, and then to test the tapped holes periodically with "go" and "not go" gages. The tap can be watched for wear by testing the tapped holes with a "go" thread gage. One widely used practice consists of using a "go" thread plug gage, and a "not go" plain plug gage for the minor diameter.

One practice of inspecting taps is to measure the several elements, such as pitch diameter, angle, and lead. Another practice consists of tapping a hole with each tap before it is issued from the tool crib and testing these tapped holes with "go" and "not go" thread plug gages.

Sometimes the tap is tested after it is returned to the tool crib. If it is correct, it is replaced in its proper compartment. If it has worn below the limit, it is discarded and work which has been produced by it is checked and corrected when necessary.

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[9] Described in BSJ Research **6**, pp. 229-237 (1931) RP272.

(*e*) Gear-Tooth Caliper for Thread Thickness.—A device which is particularly useful in the measurement of thread thickness of Acme screw threads, or of tools for producing them, is the gear-tooth caliper. With this device the depth at which the measurement is made is controlled by means of a scale and vernier or a micrometer and the thickness is determined by means of another.

(*f*) Testing of Gages.—Gages should be tested periodically for wear and to insure that the gages are properly distributed. When successive inspections in the same plant are involved, it is good practice to inspect all gages of the same nominal size against each other periodically, and to distribute these gages so that the earlier inspections are made with those which are the greatest amount inside of the component limits, while the later inspections are made with those gages closest in size to the component limits.

The original testing of a thread gage should include measurements of diameters, lead, and angle. If these elements test satisfactorily, the later inspection need be only measurements of pitch diameter.[10]

APPENDIX 4. SCREW THREADS OF TRUNCATED WHITWORTH FORM (TO BE KNOWN AS AMERICAN TRUNCATED WHITWORTH THREADS)

American War Standard

1. SCOPE

This standard gives specifications for the basic forms and dimensional limits of internal and external screw threads of Whitworth form with truncated crests, in coarse, fine, pipe (parallel), and special series, and specifications for gages intended to check threads of this kind.

2. INTERCHANGEABILITY WITH BRITISH STANDARD WHITWORTH THREADS

Truncated threads according to this standard have been originated with the idea of facilitating and reducing the production cost of a thread which is fully interchangeable with Standard Whitworth thread made according to the British Standard 84-1940.[12]

While the tools used for producing such a thread and the gages used for checking it, as described in this standard, will secure interchangeability with Standard Whitworth threads, these tools will *not* produce Standard profile Whitworth and these gages cannot be used to gage Standard profile Whitworth threads. Plain gages for major and minor diameters of the two thread systems cannot be used interchangeably, as these diameters are not the same in the two systems. However, Standard Whitworth "go" thread ring gages, "go" thread snap gages, and "go" thread plug gages will accept a Truncated Whitworth product having satisfactory pitch diameter, lead, and angle. Therefore, these gages may be used for both systems. When such gages are used for checking truncated product, they must be supplemented by plain gages designed especially for measuring truncated major and minor diameters.

It is recommended that the purchaser of component parts which are to be provided with Whitworth threads indicate clearly whether the supplier is required to produce American Truncated Whitworth threads according to this standard, or full-form British Standard Whitworth threads according to the British Standard 84-1940, or again, whether either kind of thread will be acceptable.

3. THREAD SPECIFICATIONS

1. Truncation.—The basic form of the truncated thread according to this standard has been derived from the British Standard Whitworth form of thread by reducing the major diameter of the screw by twice the amount of the height of the radial crest, by increasing the minor diameter of the nut the same amount, and by allowing the sides of the thread to intersect an imaginary cylinder at the minimum major diameter of the nut and at the maximum minor diameter of the screw. (See fig. 43.)

2. Flat or Round Tool Crest.—Unless otherwise specified, internal threads according to this standard shall be assumed to be produced by means of taps or other threading tools having flat crests when new However, the use of tools having round crests (when new), producing threads with round roots, shall be optional. Flat tool crests and the optional round tool crests are shown in figure 44.

If the thread on a component part is to have round roots, thus requiring the use of a round crested tool, this must be explicitly stated in the specification of the thread.[13]

3. Major Diameter.—The basic major diameter of Standard Whitworth, British Standard fine, and

[10] Methods of measuring pitch diameter of screw-thread gages are described in appendix 2, p. 223.

[11] This appendix is in agreement with American War Standard ASA B1.6-1944, "Screw Threads of Truncated Whitworth Form," published by the American Standards Association, 70 East 45th Street, New York 17, N. Y. (50c).

[12] These threads are British Standard Whitworth (BS Whit), British Standard Fine (BS Fine), British Standard Pipe (parallel), and British Standard screw threads, special series.

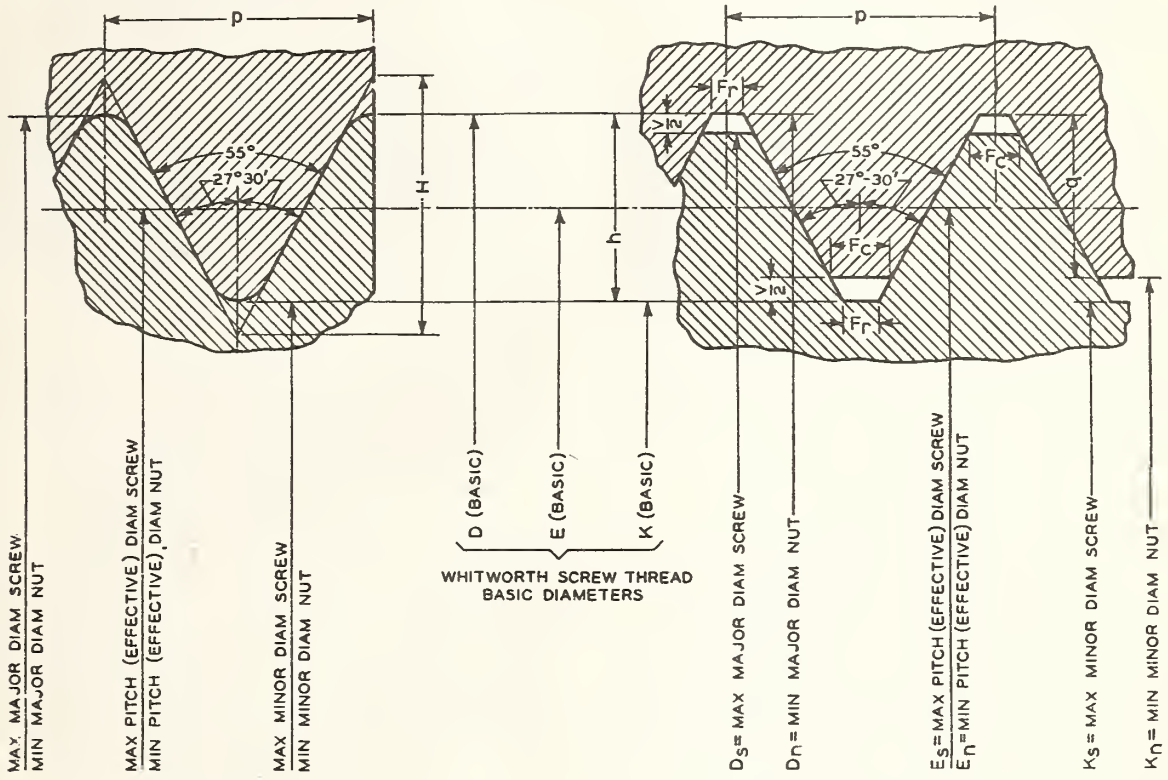
[13] Threads with round roots may be required, for example, on highly stressed screws.

Whitworth special is the same as the nominal diameter. For British Standard pipe (parallel) for general engineering purposes, the nominal diameter is arbitrary and different from the basic major diameter.

For Truncated Whitworth form, the maximum major diameter of the screw is smaller than the basic major diameter by twice the height of the radial crest. The minimum major diameter of the thread in the nut is equal to the basic major diameter of the corresponding British thread.

4. Pitch Diameter (Effective Diameter).—The pitch diameter (or effective diameter, in the British terminology) of the truncated thread is the same as that of the corresponding British thread of Whitworth form.

5. Minor Diameter.—The maximum minor diameter of the truncated screw is the same as the basic minor diameter of the corresponding British thread. The minimum minor diameter of the truncated nut is greater than the basic minor diameter by twice the height of the radial crest.



British Standard Screw Threads of Whitworth Form

Screw Threads of Truncated Whitworth Form

Figure 43.—*Screw threads of Whitworth form, Standard and Truncated.*

DIMENSIONAL SYMBOLS AND VALUES

D = Major diameter, nominal and basic
D_N = Major diameter of nut = D
D_S = Major diameter of screw = $D-V$
E = Pitch (effective) diameter, basic = $D-h$
E_N = Pitch (effective) diameter of nut = $D-h$
[1]E_S = Pitch (effective) diameter of screw Classes 1½, 2, and 3 = $D-h$
F_c = Crest width, minimum = $0.243624p$
F_r = Root width, maximum = $0.166667p$
F_s = Minimum width of flat, new chaser = $p/12$
F_t = Minimum width of flat, new tap = $p/20$
H = Height of basic triangle = $0.960491p$
h = Depth of basic thread = $0.640327p$
J = Allowance at pitch (effective) diameter = $0.05q$ = $0.02832p$
K = Minor diameter, basic = $D-2h$
K_N = Minor diameter of nut = $D-2q$
[2]K_S = Minor diameter of screw = $D-2h$
n = Number of threads per inch
p = pitch = $1/n$
q = Height of truncated thread = $0.566410p$
r = Radius of British Standard Whitworth thread = $0.137329p$
V = Double the height of segment of British Standard Whitworth crest = $0.147835p$

SCREW

Major diameter, maximum = $D-0.147835p$
Pitch (effective) diameter, maximum = $D-0.640327p$
Minor diameter, maximum = $D-1.280655p$

NUT

Major diameter, minimum = D
Pitch (effective) diameter, minimum = $D-0.640327p$
Minor diameter, minimum = $D-1.132820p$

Note 1.—E_S for class 1 is less than E_S for other classes by value J.

Note 2.—Dimensions computed by use of this formula may vary by 0.0001 inch from dimensions shown in tables 149, 150, and 151, as these dimensions have been made to agree with BS84-1940.

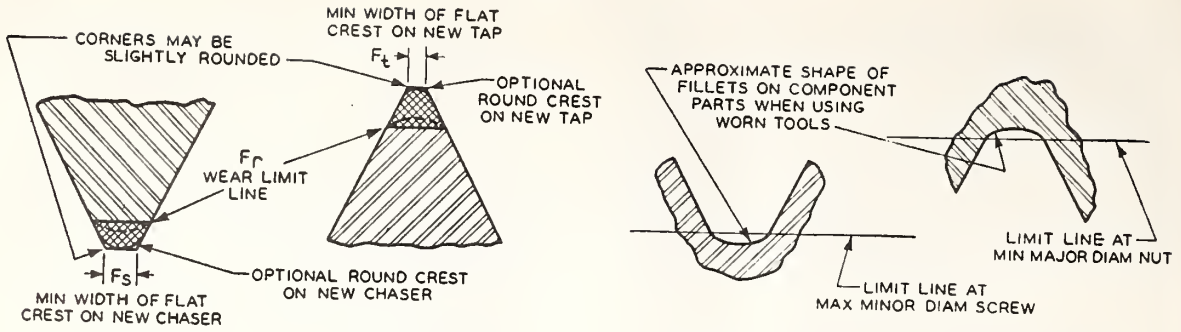


FIGURE 44.—*Forms of tool crests, Truncated Whitworth thread form.*

6. DEPTH OF THREAD.—The maximum depth of the thread is less than that of the Standard Whitworth by the amount of the height of the radial crest. However, this thread mated with a Standard Whitworth thread has the same amount of contact on its flanks as would be present if two parts with Standard Whitworth threads were mated. Also, two truncated threads mated together produce a like condition.

7. LIMITS.—The maximum major diameter, the maximum pitch diameter, and the maximum minor diameter of the screw, and the minimum major diameter, the minimum pitch diameter, and the minimum minor diameter of the nut, are given in

Table 149 for coarse threads;
Table 150 for fine threads;
Table 151 for British Standard pipe (parallel);
Table 152 for special threads, by subtracting the required value from the basic major diameter.

In all of the above cases the maximum pitch diameter of the screw and the minimum pitch diameter of the nut for a given thread are the same for all classes, except for class 1 where the maximum pitch diameter of the screw is below basic by an allowance of $0.05q$. (See footnote 1, table 148.)

The comparison with the British Standard Whitworth classes of fits is as follows:

Class 1—No British equivalent, as this class has an allowance. Pitch diameter tolerance same as class $1\frac{1}{2}$.
Class $1\frac{1}{2}$—Same as British free fit.
Class 2—Same as British medium fit.
Class 3—Same as British close fit.

8. TOLERANCES.—Tables 149, 150, 151, and 152 also give the tolerances on the diameters mentioned, except that the pitch diameter tolerances for special threads are not shown in table 152. For Standard Whitworth pitches from 40 to 4 threads per inch, however, the pitch diameter tolerances are shown as indicated below:

Classes 1, $1\frac{1}{2}$ tolerance, table 153
Class 2 tolerance, table 154
Class 3 tolerance table 155.

The minimum minor diameter of the screw and the maximum major diameter of the nut are established by the crests of new threading tools. (See fig. 44.)

The tolerance on the major diameter of the screw is based on the formula: $0.052p + 0.0030$ in. The figures given in table 152 will maintain the required minimum percentage of flank contact for special threads.

The tolerance on the minor diameter of the nut has been set to make the maximum minor diameter of the nut agree with the British Standard 84-1940.

9. IDENTIFICATION SYMBOLS.—American War Standard screw threads of Truncated Whitworth form are to be identified by the following symbols:

	EXAMPLE, MARK
TWC—Truncated Whitworth, coarse thread series	$1\frac{1}{2}$-6-TWC-2.
TWF—Truncated Whitworth, fine thread series	$\frac{1}{2}$-16-TWF-$1\frac{1}{2}$.
TWPP—Truncated Whitworth, British Standard pipe (parallel)	1-11-TWPP-2.
TWS—Truncated Whitworth, special application of pitches and diameters	1-18-TWS-3.

4. GAGES AND GAGING

1. GAGE DIMENSIONS.—Data for the limiting dimensions of gages are given below, with reference to table 156.

It is suggested that in case of question between manufacturer and purchaser of threaded products in regard to their size, if the manufacturer produces limit gages which do not measure outside of the specified limits for the threaded components, and which pass the parts in question, they be accepted as meeting the specifications for size. In case the dimensions of the gages are questioned, their sizes shall be determined by a disinterested party, preferably the National Bureau of Standards at Washington, D. C., which maintains a department for this service.

2. EXAMPLE OF GAGES.—A series of gages for checking Truncated Whitworth threads according to this standard is shown by the way of example in figs. 45, 46, and 47.

3. Gages not to be Used for British Standard Whitworth Thread.—The gage dimensions given here are intended only for gages used for checking Truncated Whitworth threads according to the present standard. Such gages shall not be used for checking British Standard Whitworth thread, but they will accept threaded product that is fully interchangeable with British Standard Whitworth product.

4. Special Requirement for Crests of Threaded "Go" Gages for this Thread.—The "go" thread ring gage for a screw shall have a minor diameter equal to the maximum minor diameter of the screw. The "go" thread plug gage shall have a major diameter equal to the minimum major diameter of the nut. While this method is a deviation from the gaging practice in use for American standard threads, it is necessary procedure with these gages in order to insure the interchangeability of threads of truncated form with threads of British Standard Whitworth form. (See fig. 48.)

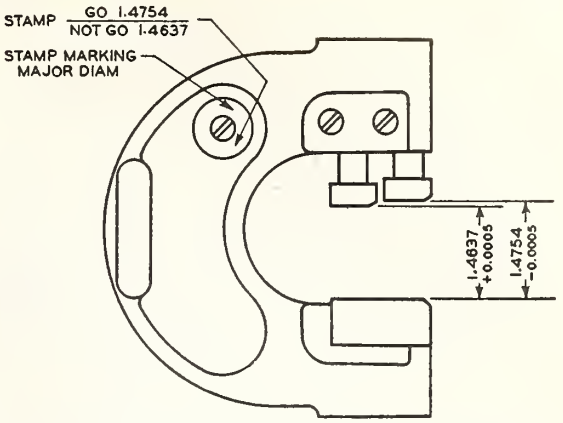
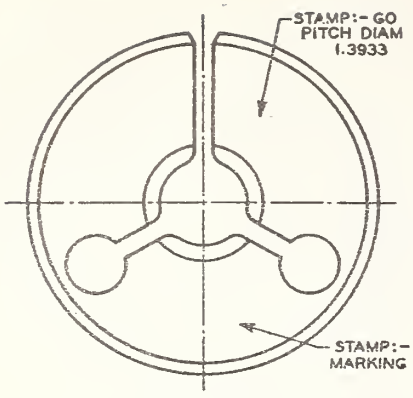
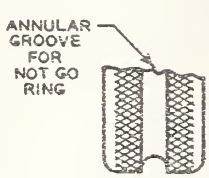
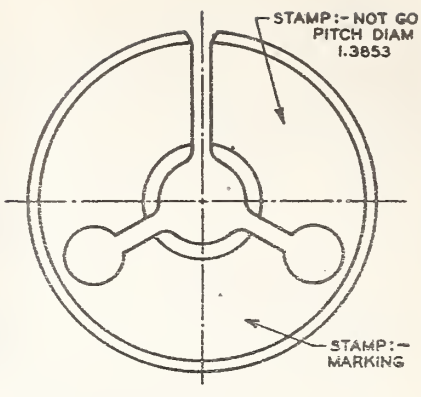


Figure 45.—*Adjustable plain snap gage (American Gage Design Standard, model C) for checking screw threads of Truncated Whitworth form; nominal diameter 1 1/2 inches; 6 threads per inch; class 2 tolerance.*

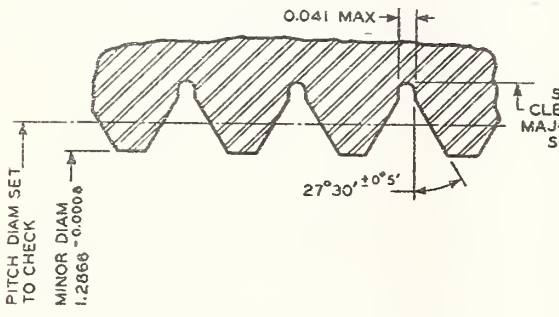


Go Thread Ring

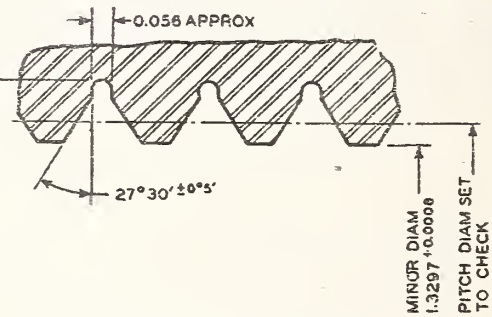




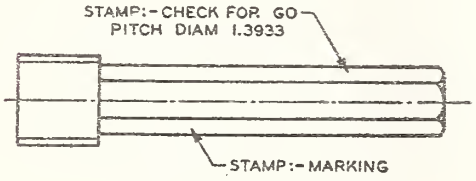
Not Go Thread Ring



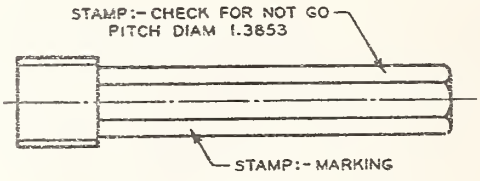
Enlarged Cross Section of Go Ring Threads



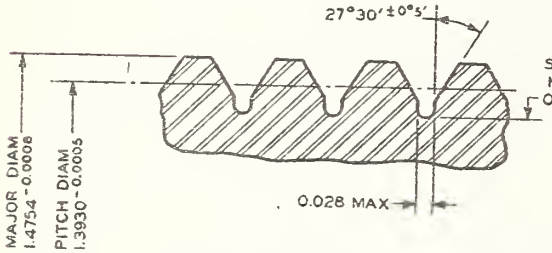
Enlarged Cross Section of Not Go Ring Threads



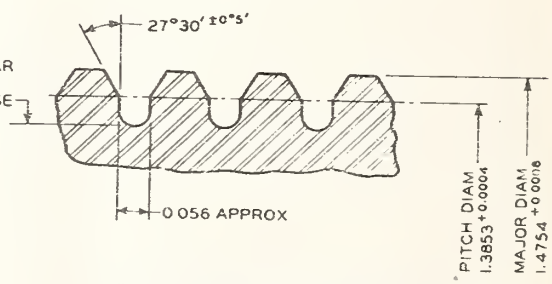
Go Check Plug Gage



Not Go Check Plug Gage



Enlarged Cross Section of Go Check Plug Threads



Enlarged Cross Section of Not Go Check Plug Threads

FIGURE 46.—*Gage data for "go" and "not go" thread ring gages and their checks for screw threads of Truncated Whitworth form; nominal diameter 1½ inches; 6 threads per inch; class 2 tolerance.*

NOTES.—Gages are to be of American Gage Design Standard. (See subsection 4(6).)
Gaging members are to be hardened, ground, and lapped.
First half-turn of end threads is to be removed to avoid feather edges.
Permissible variation in lead between any two threads, ±0.0004 inch.

5. Variation in Lead.—The values shown in Table 157, column 7 (for inspection gages) are the maximum permissible variations in lead between any two threads not farther apart than the length of the standard gage, omitting one full thread at each end of the gage. Standard gages are shown in Commercial Standard CS8-41, Gage Blanks.

6. Gage Design.—It is recommended that gages be in accordance with Commercial Standard CS8-41, Gage Blanks.

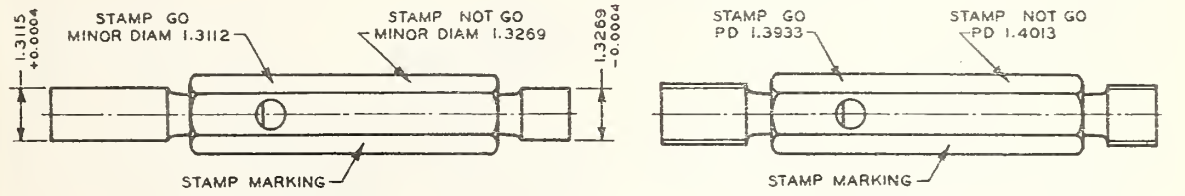
7. Thread Form of Thread Plug and Ring Gages.—The major diameter of the "go" thread plug gage is the same as the basic major diameter, with a plus gage tolerance. The minor diameter of the "go" thread ring gage is the same as the maximum minor diameter of screw, with a minus gage tolerance.

The major diameter of the "not go" thread plug is obtained by adding $p/3$ (table 157, column 8) to the maximum pitch (effective) diameter of the nut.

The minor diameter of the "not go" thread ring is obtained by subtracting $p/3$ from the minimum pitch diameter of the screw.

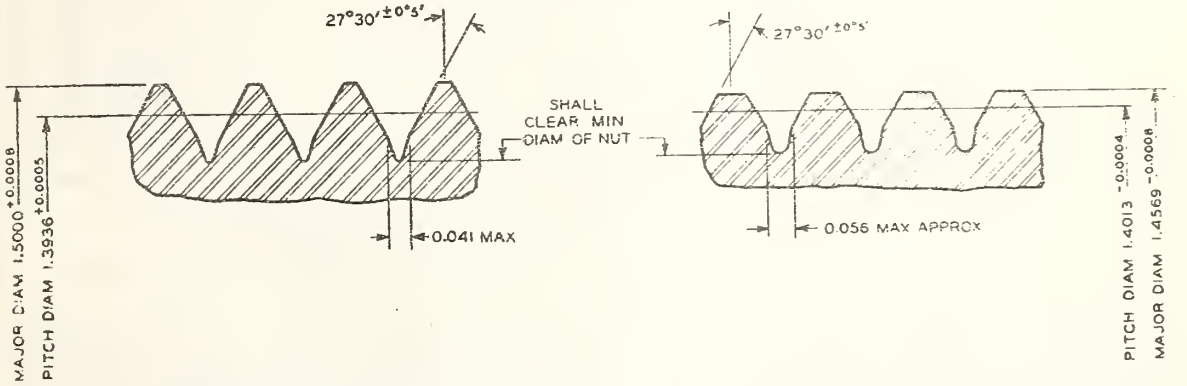
A relief with a width not greater than $0.2436p$ is provided at the root of the "go" thread plug and "go" thread ring gages. A relief with a width not greater than $p/6$ is provided at the root of the thread of the check for the "go" ring. Also, a relief which is approximately $p/3$ wide is provided at the root of the "not go" thread plug, "not go" thread ring, and "not go" check gages. The root of "go" and "not go" thread plug gages shall clear the minimum minor diameter of the nut or tapped hole, and the root of "go" and "not go" thread ring gages shall clear the maximum major diameter of the screw.

Thus, contact of the "not go" thread gage can occur on the sides of the threads but not on the crest or root. Also, the effect of the angle error on the fit between the "not go" gage and the product is minimized. The above requirements are illustrated in figure 49.



Double-Ended Plain Plug

Double-Ended Thread Plug



Enlarged Cross Section of Go Plug Threads

Enlarged Cross Section of Not Go Plug Threads

Figure 47.—*Double-ended plain and thread plug gages for checking screw threads of Truncated Whitworth form; nominal diameter 1½ inches; 6 threads per inch; class 2 tolerance.*

Notes.—Gages are to be of American Gage Design Standard.
Gaging members are to be hardened, ground and lapped.
First half-turn of end threads is to be removed to avoid feather edges.
Permissible variation in lead between any two threads, ±0.0004 inch.

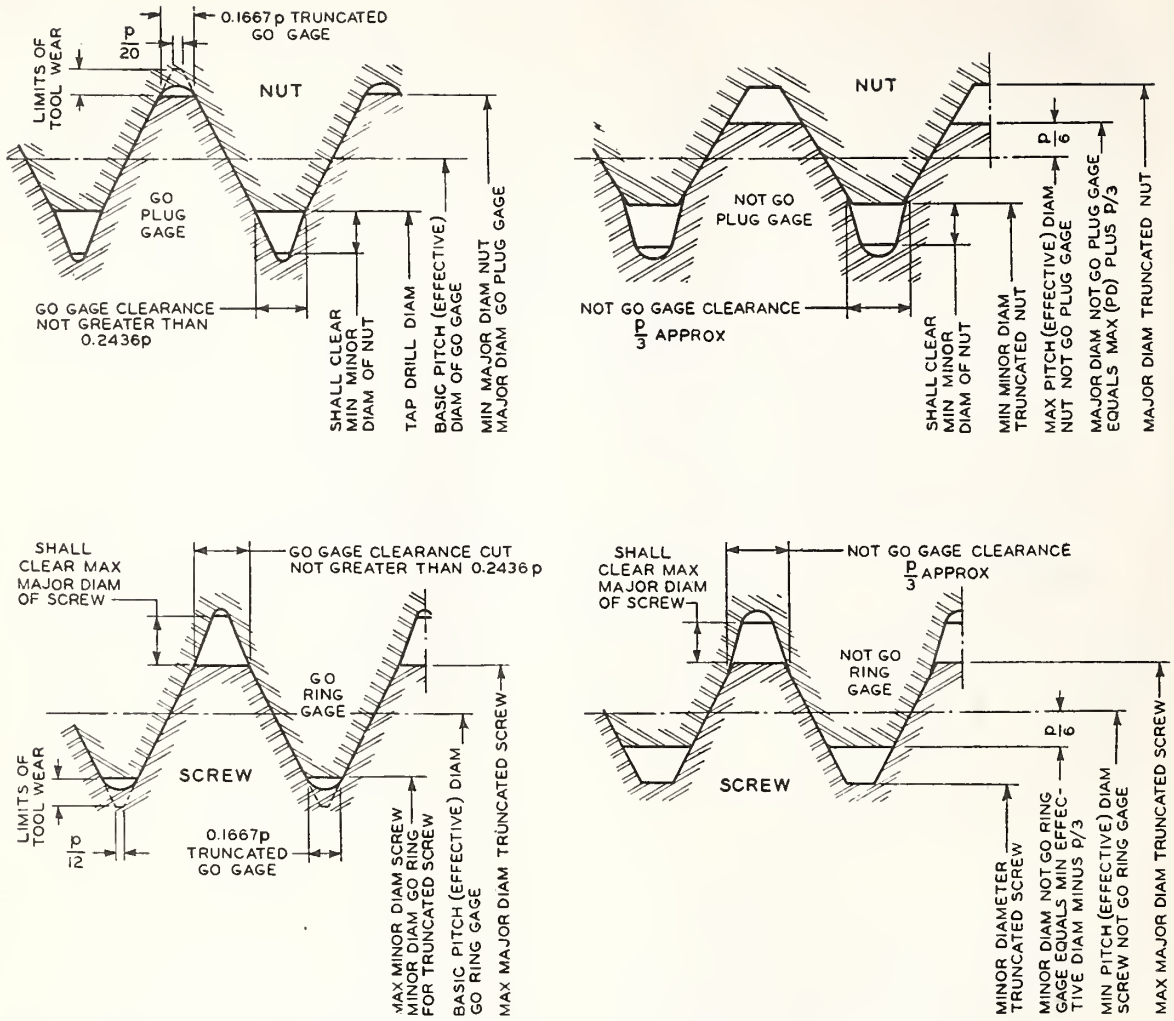


FIGURE 48.—*Profile of "go" and "not go" thread plug and ring gages for checking screw threads of Truncated Whitworth form.*

5. TAP DRILL SIZES

Suggested tap drill sizes are given in table 158 for coarse thread series; in table 159 for fine thread series of Truncated Whitworth threads; and in table 160 for Truncated Whitworth British Standard pipe (parallel).

6. EXAMPLE OF INTERCHANGEABILITY

The fit between two mating parts with Truncated Whitworth threads, nominal size 1½ inches and 6 threads per inch, is shown in figure 49. This also shows the interchangeability between Truncated Whitworth thread and British Standard Whitworth thread.

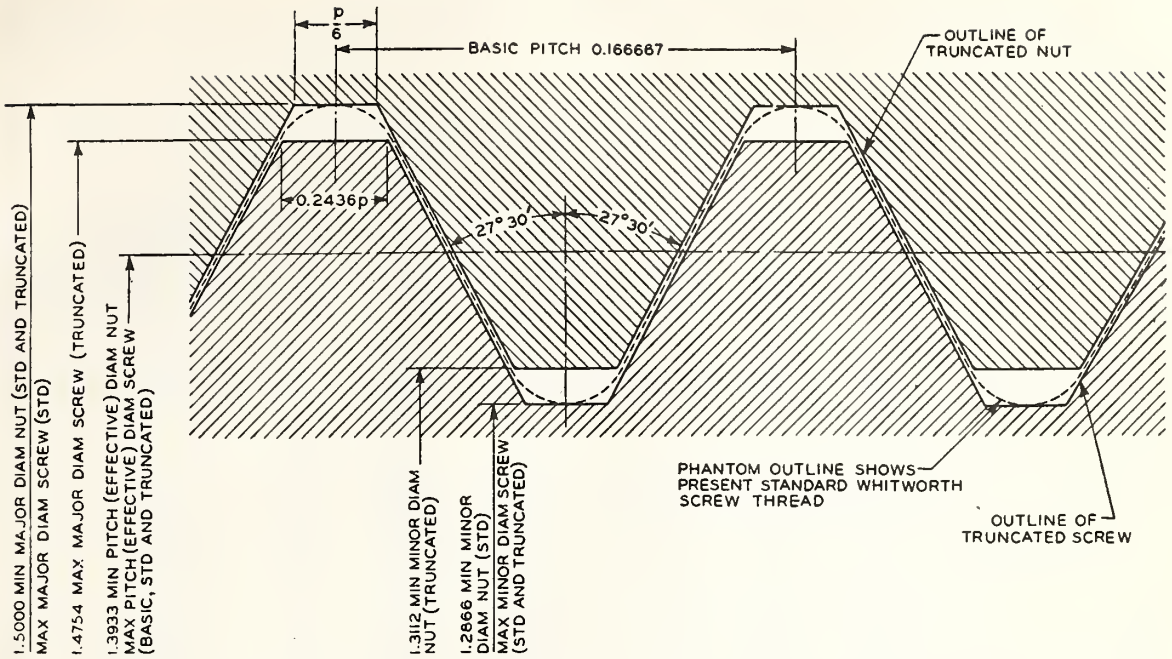


FIGURE 49.—*Example of screw threads of Truncated Whitworth form, coarse series; nominal diameter 1½ inches; 6 threads per inch; class 2 tolerance; length of engagement 1½ inches.*

NOTE.—In this drawing clearance has been shown between the threads for the purpose of accentuating the outline of the thread forms. However, under maximum metal conditions the full length of the flanks of any combination of the four units is in metal-to-metal contact.

COMPARATIVE DIMENSIONS OF STANDARD WHITWORTH AND TRUNCATED WHITWORTH THREAD FORMS

Dimensions of thread	Standard	Truncated
SCREW	*Inches*	*Inches*
Major diameter	1.5000 - 0.0121	1.4754 - 0.0117
Pitch (effective) diameter	1.3933 - 0.0080	1.3933 - 0.0080
Minor diameter	1.2866 - 0.0162	1.2866 maximum
NUT		
Major diameter	1.5000 minimum	1.5000 minimum
Pitch (effective) diameter	1.3933 +0.0080	1.3933 +0.0080
Minor diameter	1.2866 +0.0403	1.3112 +0.0157

TABLE 148.—*Thread data, screw threads of Truncated Whitworth form, symbol values for each pitch*

Threads per inch, n	p	h	q	F_c	F_r	F_s	F_t	J	V	%[1]
1	2	3	4	5	6	7	8	9	10	11
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	
40	0.025000	0.016008	0.014160	0.0061	0.0042	0.0021	0.00125	0.0007	0.003696	61.0
36	.027778	.017787	.015734	.0068	.0046	.0023	.0014	.0008	.004107	63.8
32	.031250	.020010	.017700	.0076	.0052	.0026	.0016	.0009	.004620	66.9
28	.035714	.022869	.020229	.0087	.0060	.0030	.0018	.0010	.005280	69.6
26	.038462	.024628	.021765	.0094	.0064	.0032	.0019	.0011	.005686	71.0
24	.041667	.026681	.023601	.0102	.0069	.0035	.0021	.0012	.006160	70.0
22	.045455	.029106	.025746	.0111	.0076	.0038	.0023	.0013	.006720	71.4
20	.050000	.032016	.028320	.0122	.0083	.0042	.0025	.0014	.007392	69.1
18	.055556	.035574	.031467	.0135	.0093	.0046	.0028	.0016	.008213	71.1
16	.062500	.040020	.035401	.0152	.0104	.0052	.0031	.0018	.009240	73.2
14	.071429	.045738	.040458	.0174	.0119	.0060	.0036	.0020	.010560	75.3
12	.083333	.053360	.047201	.0203	.0139	.0069	.0042	.0024	.012320	77.2
11	.090909	.058211	.051492	.0221	.0152	.0076	.0045	.0026	.013440	78.2
10	.100000	.064033	.056641	.0244	.0167	.0083	.0050	.0028	.014784	79.3
9	.111111	.071147	.062934	.0271	.0185	.0093	.0056	.0031	.016426	80.3
8	.125000	.080041	.070801	.0305	.0208	.0104	.00625	.0035	.018479	81.3
7	.142857	.091475	.080916	.0348	.0238	.0119	.0071	.0040	.021119	82.3
6	.166667	.106721	.094402	.0406	.0278	.0139	.0083	.0047	.024639	83.3
5	.200000	.128065	.113282	.0487	.0333	.0167	.0100	.0057	.029567	84.4
4½	.222222	.142295	.125869	.0541	.0370	.0185	.0111	.0063	.032852	84.9
4	.250000	.160082	.141602	.0609	.0417	.0208	.0125	.0071	.036959	85.4
3½	.285714	.182950	.161831	.0696	.0476	.0238	.0143	.0081	.042239	85.9

[1] Percentage of minimum flank contact to basic flank contact equals $\frac{2\ (h-V) - (\text{tol. } D_S + \text{tol. } E_N)}{2(h-V)} \times 100$.

TABLE 149.—*Screw threads of Truncated Whitworth form, coarse thread series*

Sizes	Threads per inch, n	Pitch, $\frac{1}{n}$	Screw								Nut						
			Major diameter, truncated		Pitch (effective) diameter					Minor diameter,[2] maximum	Major diameter, minimum	Pitch (effective) diameter				Minor diameter, truncated	
					Maximum		Tolerance, apply minus[1]					Minimum	Tolerance, apply plus[1]			Minimum	Tolerance, apply plus, all classes
			Maximum	Tolerance, apply minus, all classes	Class 1	Classes 1½, 2, and 3	Loose, class 1; free, class 1½	Medium, class 2	Close, class 3				Loose, class 1; free, class 1½	Medium, class 2	Close, class 3		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	16	17	18
Inches		*Inch*	*Inches*	*Inch*	*Inches*	*Inches*	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inch*	*Inch*	*Inch*	*Inches*	*Inch*
⅛	40	0.02500	0.1213	0.0043	0.1083	0.1090	0.0043	0.0029	0.0019	0.0930	0.1250	0.1090	0.0043	0.0029	0.0019	0.0967	0.0053
3/16	24	.04167	.1813	.0052	.1596	.1608	.0052	.0035	.0023	.1341	.1875	.1608	.0052	.0035	.0023	.1403	.0071
¼	20	.05000	.2426	.0056	.2166	.2180	.0058	.0039	.0026	.1860	.2500	.2180	.0058	.0039	.0026	.1934	.0096
5/16	18	.05556	.3043	.0059	.2753	.2769	.0063	.0042	.0028	.2413	.3125	.2769	.0063	.0042	.0028	.2495	.0099
⅜	16	.06250	.3658	.0062	.3332	.3350	.0068	.0045	.0030	.2950	.3750	.3350	.0068	.0045	.0030	.3042	.0103
7/16	14	.07143	.4269	.0067	.3898	.3918	.0073	.0048	.0032	.3461	.4375	.3918	.0073	.0048	.0032	.3567	.0107
½	12	.08333	.4877	.0073	.4442	.4466	.0077	.0052	.0034	.3932	.5000	.4466	.0077	.0052	.0034	.4055	.0114
9/16	12	.08333	.5502	.0073	.5067	.5091	.0080	.0053	.0036	.4557	.5625	.5091	.0080	.0053	.0036	.4680	.0114
5/8	11	.09091	.6116	.0077	.5642	.5668	.0084	.0056	.0037	.5086	.6250	.5668	.0084	.0056	.0037	.5220	.0118
1 1/16[3]	11	.09091	.6741	.0077	.6267	.6293	.0086	.0058	.0038	.5711	.6876	.6293	.0086	.0058	.0038	.5845	.0118
¾	10	.10000	.7352	.0082	.6832	.6860	.0090	.0060	.0040	.6220	.7500	.6860	.0090	.0060	.0040	.6368	.0122
7/8	9	.11111	.8586	.0088	.8008	.8039	.0096	.0064	.0043	.7328	.8750	.8039	.0096	.0064	.0043	.7492	.0128
1	8	.12500	.9815	.0095	.9165	.9200	.0102	.0068	.0046	.8400	1.0000	.9200	.0102	.0068	.0045	.8585	.0135
1⅛	7	.14286	1.1039	.0104	1.0295	1.0335	.0107	.0072	.0048	.9420	1.1250	1.0335	.0107	.0072	.0048	.9631	.0145
1¼	7	.14286	1.2289	.0104	1.1545	1.1585	.0111	.0074	.0049	1.0670	1.2500	1.1585	.0111	.0074	.0049	1.0881	.0145
1½	6	.16667	1.4754	.0117	1.3886	1.3933	.0120	.0080	.0053	1.2866	1.5000	1.3933	.0120	.0080	.0053	1.3112	.0157
1¾	5	.20000	1.7204	.0134	1.6162	1.6219	.0129	.0086	.0057	1.4938	1.7500	1.6219	.0129	.0086	.0057	1.5234	.0174
2	4½	.22222	1.9671	.0146	1.8514	1.8577	.0137	.0091	.0061	1.7154	2.0000	1.8577	.0137	.0091	.0061	1.7483	.0185
2¼	4	.25000	2.2130	.0160	2.0818	2.0899	.0144	.0096	.0064	1.9298	2.2500	2.0899	.0144	.0096	.0064	1.9668	.0200
2½	4	.25000	2.4630	.0160	2.3328	2.3399	.0149	.0100	.0066	2.1798	2.5000	2.3399	.0149	.0100	.0066	2.2168	.0200
2¾	3½	.28571	2.7078	.0179	2.5589	2.5670	.0157	.0104	.0070	2.3840	2.7500	2.5670	.0157	.0104	.0070	2.4262	.0219
3	3½	.28571	2.9578	.0179	2.8089	2.8170	.0161	.0108	.0072	2.6340	3.0000	2.8170	.0161	.0108	.0072	2.6762	.0219

[1] The tolerance on pitch diameter includes all variations in lead and angle. The values for pitch diameter tolerances given in this table are based on a length of engagement equal to the basic major diameter, but may be used for lengths of engagement up to 1½ diameters.

[2] The minimum minor diameter of the screw is established by the crest of a new chaser (see F_s, fig. 44), and the maximum major diameter of the nut, by the crest of a new tap (see F_t, fig. 44).

[3] To be dispensed with wherever possible.

TABLE 150.— *Screw threads of Truncated Whitworth form, fine thread series*

Size	Threads per inch, n	Pitch, $\frac{1}{n}$	Screw								Nut						
			Major diameter, truncated		Pitch (effective) diameter					Minor diameter,[2] maximum	Major diameter, minimum	Pitch (effective) diameter				Minor diameter, truncated	
					Maximum		Tolerance, apply minus[1]						Tolerance, apply plus				
			Maximum	Tolerance, apply minus, all classes	Class 1	Classes 1½, 2 and 3	Loose, class 1; free class 1½	Medium, class 2	Close, class 3			Minimum	Loose, class 1; free, class 1½	Medium, class 2	Close, class 3	Minimum	Tolerance, apply plus, all classes
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Inches		*Inch*	*Inches*	*Inch*	*Inches*	*Inches*	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inch*	*Inch*	*Inch*	*Inches*	*Inch*
3/16	32	0.03125	0.1829	0.0046	0.1666	0.1675	0.0050	0.0033	0.0022	0.1475	0.1875	0.1675	0.0050	0.0033	0.0022	0.1521	0.0056
7/32	28	.03571	.2135	.0049	.1949	.1959	.0053	.0036	.0024	.1730	.2188	.1959	.0053	.0036	.0024	.1783	.0058
1/4	26	.03846	.2443	.0050	.2243	.2254	.0056	.0037	.0025	.2008	.2500	.2254	.0056	.0037	.0025	.2065	.0060
9/32	26	.03846	.2755	.0050	.2555	.2566	.0058	.0039	.0026	.2320	.2812	.2566	.0058	.0039	.0026	.2377	.0060
5/16	22	.04545	.3058	.0054	.2821	.2834	.0062	.0041	.0027	.2543	.3125	.2834	.0062	.0041	.0027	.2610	.0074
3/8	20	.05000	.3676	.0056	.3416	.3430	.0066	.0044	.0029	.3110	.3750	.3430	.0066	.0044	.0029	.3184	.0096
7/16	18	.05556	.4293	.0059	.4003	.4019	.0070	.0047	.0031	.3663	.4375	.4019	.0070	.0047	.0031	.3745	.0099
1/2	16	.06250	.4908	.0062	.4582	.4600	.0074	.0050	.0033	.4200	.5000	.4600	.0074	.0050	.0033	.4292	.0103
9/16	16	.06250	.5533	.0062	.5207	.5225	.0077	.0052	.0034	.4825	.5625	.5225	.0077	.0052	.0034	.4917	.0103
5/8	14	.07143	.6144	.0067	.5773	.5793	.0081	.0054	.0036	.5336	.6250	.5793	.0081	.0054	.0036	.5442	.0107
11/16	14	.07143	.6769	.0067	.6398	.6418	.0084	.0056	.0037	.5961	.6875	.6418	.0084	.0056	.0037	.6067	.0107
3/4	12	.08333	.7377	.0073	.6942	.6966	.0088	.0059	.0039	.6432	.7500	.6966	.0088	.0059	.0039	.6555	.0114
13/16	12	.08333	.8002	.0073	.7567	.7591	.0090	.0060	.0040	.7057	.8125	.7591	.0090	.0060	.0040	.7180	.0114
7/8	11	.09091	.8616	.0077	.8142	.8168	.0093	.0062	.0042	.7586	.8750	.8168	.0093	.0062	.0042	.7720	.0118
1	10	.10000	.9852	.0082	.9332	.9360	.0099	.0066	.0044	.8720	1.0000	.9360	.0099	.0066	.0044	.8868	.0122
1 1/8	9	.11111	1.1086	.0088	1.0508	1.0539	.0104	.0069	.0046	.9828	1.1250	1.0539	.0104	.0069	.0046	.9992	.0128
1 1/4	9	.11111	1.2336	.0088	1.1758	1.1789	.0108	.0072	.0048	1.1078	1.2500	1.1789	.0108	.0072	.0048	1.1242	.0128
1 3/8	8	.12500	1.3565	.0095	1.2915	1.2950	.0113	.0075	.0050	1.2150	1.3750	1.2950	.0113	.0075	.0050	1.2335	.0135
1 1/2	8	.12500	1.4815	.0095	1.4165	1.4200	.0116	.0077	.0052	1.3400	1.5000	1.4200	.0116	.0077	.0052	1.3585	.0135

[1] The tolerance on pitch diameter includes all variations in lead and angle. The values for pitch diameter tolerances given in this table are based on a length of engagement equal to the basic major diameter, but may be used for lengths of engagement up to 1½ diameters.

[2] The minimum minor diameter of the screw is established by the crest of a new chaser (see F_s, fig. 44), and the maximum major diameter of the nut, by the crest of a new tap (see F_t, fig. 44).

TABLE 151.—*Screw threads of Truncated Whitworth form, British Standard pipe (parallel, for general engineering purposes)*

Size	Threads, per inch, n	Pitch, $1/n$	Screw							Nut						
			Major diameter, truncated		Pitch (effective) diameter				Minor diameter,[2] maximum	Major diameter, minimum	Pitch (effective) diameter				Minor diameter, truncated	
			Maximum	Tolerance, apply minus, all classes	Maximum, all classes	Tolerance,[1] (apply minus)					Minimum, all classes	Tolerance,[1] (apply plus)			Minimum	Tolerance, apply plus, all classes
						Free, class 1½	Medium, class 2	Close, class 3				Free, class 1½	Medium, class 2	Close, class 3		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Inches		*Inch*	*Inches*	*Inch*	*Inches*	*Inch*	*Inch*	*Inch*	*Inches*	*Inches*	*Inches*	*Inch*	*Inch*	*Inch*	*Inches*	*Inch*
⅛.....	28	0.03571	0.3777	0.0049	0.3601	0.0064	0.0042	0.0028	0.3372	0.3830	0.3601	0.0064	0.0042	0.0028	0.3425	0.0058
¼.....	19	.05263	.5102	.0057	.4843	.0073	.0049	.0032	.4506	.5180	.4843	.0073	.0049	.0032	.4584	.0097
⅜.....	19	.05263	.6482	.0057	.6223	.0075	.0050	.0033	.5886	.6560	.6223	.0075	.0050	.0033	.5964	.0097
½.....	14	.07143	.8144	.0067	.7793	.0084	.0056	.0037	.7336	.8250	.7793	.0084	.0056	.0037	.7442	.0107
⅝.....	14	.07143	.8914	.0067	.8563	.0085	.0056	.0038	.8106	.9020	.8563	.0085	.0056	.0038	.8212	.0107
¾.....	14	.07143	1.0304	.0067	.9953	.0089	.0060	.0040	.9496	1.0410	.9953	.0089	.0060	.0040	.9602	.0107
⅞.....	14	.07143	1.1784	.0067	1.1433	.0091	.0061	.0040	1.0976	1.1890	1.1433	.0091	.0061	.0040	1.1082	.0107
1.....	11	.09091	1.2956	.0077	1.2508	.0098	.0065	.0043	1.1926	1.3090	1.2508	.0098	.0065	.0043	1.2060	.0118
1¼.....	11	.09091	1.6366	.0077	1.5918	.0103	.0069	.0046	1.5336	1.6500	1.5918	.0103	.0069	.0046	1.5470	.0118
1½.....	11	.09091	1.8686	.0077	1.8238	.0107	.0072	.0048	1.7656	1.8820	1.8238	.0107	.0072	.0048	1.7790	.0118

[1] The tolerance on pitch diameter includes all variations in lead and angle. The values for pitch diameter tolerances given in this table are based on a length of engagement equal to the basic major diameter, but may be used for lengths of engagement up to 1½ diameters.

[2] The minimum minor diameter of the screw is established by the crest of a new chaser (see F_s, fig. 44), and the maximum major diameter of the nut, by the crest of a new tap (see F_t, fig. 44).

TABLE 152.—*Screw threads of Truncated Whitworth form, special thread series, recommended pitches for special diameters and lengths of engagement*

To obtain desired diameters, subtract values listed below from basic major diameter, as indicated, and use given tolerances.

Pitch[1] (effective) diameter tolerances for class 1 (loose) and class 1½ (free) see .....table 153.
for class 2 (medium) see.....table 154.
for class 3 (close) see.....table 155.

Threads per inch, n	Pitch, $1/n$	Screw					Nut			
		Major diameter, truncated		Pitch (effective) diameter, maximum		Minor diameter,[2] maximum	Major diameter, minimum	Pitch (effective) diameter, minimum	Minor diameter, truncated	
		Maximum	Tolerance (apply minus)	Class 1	Classes 1½, 2, and 3				Minimum	Tolerance (apply plus)
1	2	3	4	5	6	7	8	9	10	11
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
40.....	0.02500	0.0037	0.0043	.....	0.0160	0.0320	0.0000	0.0160	0.0283	0.0053
36.....	.02778	.0041	.0044	.....	.0178	.0356	.0000	.0178	.0315	.0055
32.....	.03125	.0046	.0046	.....	.0200	.0400	.0000	.0200	.0354	.0056
28.....	.03571	.0053	.0049	.....	.0229	.0457	.0000	.0229	.0405	.0058
26.....	.03846	.0057	.0050	0.0257	.0246	.0493	.0000	.0246	.0436	.0060
24.....	.04167	.0062	.0052	.0279	.0267	.0534	.0000	.0267	.0472	.0071
20.....	.05000	.0074	.0056	.0334	.0320	.0640	.0000	.0320	.0566	.0096
18.....	.05556	.0082	.0059	.0372	.0356	.0711	.0000	.0356	.0629	.0099
16.....	.06250	.0092	.0062	.0418	.0400	.0800	.0000	.0400	.0708	.0103
14.....	.07143	.0106	.0067	.0477	.0457	.0915	.0000	.0457	.0809	.0107
12.....	.08333	.0123	.0073	.0558	.0534	.1067	0000	.0534	.0944	.0114
10.....	.10000	.0148	.0082	.0668	.0640	.1281	.0000	.0640	.1133	.0122
8.....	.12500	.0185	.0095	.0835	.0800	.1601	.0000	.0800	.1416	.0135
6.....	.16667	.0246	.0117	.1114	.1067	.2134	.0000	.1067	.1888	.0157
4.....	.25000	.0370	.0160	.1672	.1601	.3202	.0000	.1601	.2832	.0200

[1] The tolerance on pitch (effective) diameter includes all variations in lead and angle. The values for pitch (effective) diameter tolerances given in this table are based on a length of engagement equal to the basic major diameter, but may be used for lengths of engagement up to 1½ diameters.

[2] The minimum minor diameter of the screw is established by the crest of a new chaser (see F_s, fig. 44) and the maximum major diameter of the nut, by the crest of a new tap (see F_t, fig. 44).

TABLE 153.—*Whitworth screw threads of special diameters, pitches, and lengths of engagement pitch (effective) diameter tolerances, classes 1 (loose) and 1 1/2 (free)*

Threads per inch	Lengths of engagement		Pitch diameter tolerances for diameters up to and including—											
	From—	To and including—	1/4 inch	1/2 inch	3/4 inch	1 1/4 inches	2 inches	3 inches	4 inches	6 inches	8 inches	11 inches	15 inches	20 inches
	Inches	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
26, 24..	1/4	3/8	0.0058	0.0062	0.0066	0.0070	0.0076	0.0081	.....	.....	.....	.....	.....	.....
	3/8	1/2	.0062	.0067	.0071	.0075	.0080	.0086	.....	.....	.....	.....	.....	.....
	1/2	3/4	.0068	.0073	.0077	.0081	.0086	.....	.....	.....	.....	.....	.....	.....
	3/4	1	.....	.0079	.0083	.0087	.....	.....	.....	.....	.....	.....	.....	.....
20.....	1/4	3/8	.....	.0064	.0068	.0072	.0077	.0083	.....	.....	.....	.....	.....	.....
	3/8	1/2	.....	.0068	.0072	.0077	.0082	.0087	.....	.....	.....	.....	.....	.....
	1/2	3/4	.....	.0074	.0078	.0082	.0088	.0093	.....	.....	.....	.....	.....	.....
	3/4	1	.....	.0080	.0085	.0089	.0094	.0100	.....	.....	.....	.....	.....	.....
18, 16..	1/4	3/8	.....	.0066	.0070	.0074	.0079	.0085	0.0089	0.0095	.....	.....	.....	.....
	3/8	1/2	.....	.0070	.0074	.0079	.0084	.0089	.0094	.0100	.....	.....	.....	.....
	1/2	3/4	.....	.0076	.0080	.0084	.0090	.0095	.0100	.0106	.....	.....	.....	.....
	3/4	1	.....	.0082	.0086	.0091	.0096	.0102	.0106	.....	.....	.....	.....	.....
	1	1 1/2	.....	.0091	.0095	.0099	.0104	.0110	.....	.....	.....	.....	.....	.....
14, 12..	3/8	1/2	.....	.....	.0077	.0081	.0087	.0092	.0097	.0103	.....	.....	.....	.....
	1/2	3/4	.....	.....	.0083	.0087	.0092	.0098	.0103	.0109	.....	.....	.....	.....
	3/4	1	.....	.....	.0089	.0094	.0099	.0104	.0109	.0115	.....	.....	.....	.....
	1	1 1/2	.....	.....	.0098	.0102	.0107	.0113	.0118	.0123	.....	.....	.....	.....
	1 1/2	2	.....	.....	.....	.0111	.0116	.0122	.0127	.0132	.....	.....	.....	.....
10.....	3/8	1/2	.....	.....	.....	.0083	.0089	.0094	.0099	.0105	0.0111	.....	.....	.....
	1/2	3/4	.....	.....	.....	.0089	.0095	.0100	.0105	.0111	.0117	.....	.....	.....
	3/4	1	.....	.....	.....	.0096	.0101	.0107	.0111	.0117	.0123	.....	.....	.....
	1	1 1/2	.....	.....	.....	.0104	.0109	.0115	.0120	.0125	.0131	.....	.....	.....
	1 1/2	2	.....	.....	.....	.0113	.0119	.0124	.0129	.0135	.0141	.....	.....	.....
8.....	1/2	3/4	.....	.....	.....	.0092	.0097	.0103	.0108	.0113	.0119	0.0126	.....	.....
	3/4	1	.....	.....	.....	.0099	.0104	.0109	.0114	.0120	.0126	.0132	.....	.....
	1	1 1/2	.....	.....	.....	.0107	.0112	.0118	.0122	.0128	.0134	.0140	.....	.....
	1 1/2	2	.....	.....	.....	.0116	.0121	.0127	.0132	.0137	.0143	.0150	.....	.....
	2	3	.....	.....	.....	.0128	.0133	.0138	.0143	.0149	.0155	.....	.....	.....
6.....	3/4	1	.....	.....	.....	.....	.0108	.0113	.0118	.0124	.0130	.0136	0.0143	.....
	1	1 1/2	.....	.....	.....	.....	.0116	.0122	.0126	.0132	.0138	.0144	.0151	.....
	1 1/2	2	.....	.....	.....	.....	.0125	.0131	.0136	.0141	.0148	.0154	.0161	.....
	2	3	.....	.....	.....	.....	.0137	.0142	.0147	.0153	.0159	.0165	.0172	.....
	3	4	.....	.....	.....	.....	.0150	.0156	.0160	.0166	.0172	.0178	.....	.....
4.....	1	1 1/2	.....	.....	.....	.....	.....	.0129	.0133	.0139	.0145	.0151	.0158	0.0166
	1 1/2	2	.....	.....	.....	.....	.....	.0138	.0143	.0148	.0154	.0161	.0168	.0175
	2	3	.....	.....	.....	.....	.....	.0149	.0154	.0160	.0166	.0172	.0179	.0187
	3	4	.....	.....	.....	.....	.....	.0162	.0167	.0173	.0179	.0185	.0192	.0200
	4	6	.....	.....	.....	.....	.....	.0179	.0184	.0189	.0196	.0202	.0209	.0216

TABLE 154.—*Whitworth screw threads of special diameters, pitches, and lengths of engagement pitch (effective) diameter tolerances, class 2 (medium)*

Threads per inch	Lengths of engagement		Pitch diameter tolerances for diameters up to the including—											
	From—	To and including—	¼ inch	½ inch	¾ inch	1¼ inches	2 inches	3 inches	4 inches	6 inches	8 inches	11 inches	15 inches	20 inches
	Inches	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
40, 36..	⅛	¼	0.0033	0.0036	0.0038	0.0041	0.0045	.....	.....	.....	.....	.....	.....	.....
	¼	⅜	.0037	.0040	.0042	.0045	.0049	.....	.....	.....	.....	.....	.....	.....
	⅜	½	.0040	.0043	.0045	.0048	.....	.....	.....	.....	.....	.....	.....	.....
32, 28..	⅛	¼	.0034	.0037	.0040	.0042	.0046	.....	.....	.....	.....	.....	.....	.....
	¼	⅜	.0038	.0041	.0043	.0046	.0050	.....	.....	.....	.....	.....	.....	.....
	⅜	½	.0041	.0044	.0046	.0049	.0053	.....	.....	.....	.....	.....	.....	.....
	½	¾	.0045	.0048	.0050	.0053	.....	.....	.....	.....	.....	.....	.....	.....
26, 24..	¼	⅜	.0038	.0041	.0044	.0047	.0050	0.0054	.....	.....	.....	.....	.....	.....
	⅜	½	.0041	.0044	.0047	.0050	.0054	.0057	.....	.....	.....	.....	.....	.....
	½	¾	.0045	.0048	.0051	.0054	.0057	.....	.....	.....	.....	.....	.....	.....
	¾	1	.....	.0053	.0055	.0058	.....	.....	.....	.....	.....	.....	.....	.....
20.....	¼	⅜	.....	.0042	.0045	.0048	.0051	.0055	.....	.....	.....	.....	.....	.....
	⅜	½	.....	.0045	.0048	.0051	.0055	.0058	.....	.....	.....	.....	.....	.....
	½	¾	.....	.0049	.0052	.0055	.0058	.0062	.....	.....	.....	.....	.....	.....
	¾	1	.....	.0054	.0056	.0059	.0063	.0066	.....	.....	.....	.....	.....	.....
18, 16..	¼	⅜	.....	.0044	.0046	.0049	.0053	.0056	0.0060	0.0063	.....	.....	.....	.....
	⅜	½	.....	.0047	.0049	.0052	.0056	.0059	.0063	.0067	.....	.....	.....	.....
	½	¾	.....	.0051	.0053	.0056	.0060	.0063	.0067	.0070	.....	.....	.....	.....
	¾	1	.....	.0055	.0058	.0061	.0064	.0068	.0071	.....	.....	.....	.....	.....
	1	1½	.....	.0060	.0063	.0066	.0070	.0073	.....	.....	.....	.....	.....	.....
14, 12..	⅜	½	.....	.....	.0051	.0054	.0058	.0061	.0065	.0068	.....	.....	.....	.....
	½	¾	.....	.....	.0055	.0058	.0062	.0065	.0069	.0072	.....	.....	.....	.....
	¾	1	.....	.....	.0060	.0062	.0066	.0070	.0073	.0077	.....	.....	.....	.....
	1	1½	.....	.....	.0065	.0068	.0071	.0075	.0078	.0082	.....	.....	.....	.....
	1½	2	.....	.....	.....	.0074	.0078	.0081	.0084	.0088	.....	.....	.....	.....
10.....	⅜	½	.....	.....	.....	.0056	.0059	.0063	.0066	.0070	0.0074	.....	.....	.....
	½	¾	.....	.....	.....	.0060	.0063	.0067	.0070	.0074	.0078	.....	.....	.....
	¾	1	.....	.....	.....	.0064	.0067	.0071	.0074	.0078	.0082	.....	.....	.....
	1	1½	.....	.....	.....	.0069	.0073	.0076	.0080	.0084	.0088	.....	.....	.....
	1½	2	.....	.....	.....	.0076	.0079	.0083	.0086	.0090	.0094	.....	.....	.....
8.....	½	¾	.....	.....	.....	.0061	.0065	.0069	.0072	.0076	.0080	0.0084	.....	.....
	¾	1	.....	.....	.....	.0066	.0069	.0073	.0076	.0080	.0084	.0088	.....	.....
	1	1½	.....	.....	.....	.0071	.0075	.0078	.0082	.0085	.0089	.0094	.....	.....
	1½	2	.....	.....	.....	.0077	.0081	.0085	.0088	.0092	.0096	.0100	.....	.....
	2	3	.....	.....	.....	.0085	.0089	.0092	.0095	.0099	.0103	.....	.....	.....
6.....	¾	1	.....	.....	.....	.....	.0072	.0076	.0079	.0083	.0087	.0091	0.0096	.....
	1	1½	.....	.....	.....	.....	.0077	.0081	.0084	.0088	.0092	.0096	.0101	.....
	1½	2	.....	.....	.....	.....	.0084	.0087	.0090	.0094	.0098	.0102	.0107	.....
	2	3	.....	.....	.....	.....	.0091	.0095	.0098	.0102	.0106	.0110	.0115	.....
	3	4	.....	.....	.....	.....	.0100	.0104	.0107	.0111	.0115	.0119	.....	.....
4.....	1	1½	.....	.....	.....	.....	.....	.0086	.0089	.0093	.0097	.0101	.0106	0.0110
	1½	2	.....	.....	.....	.....	.....	.0092	.0095	.0099	.0103	.0107	.0112	.0117
	2	3	.....	.....	.....	.....	.....	.0100	.0103	.0107	.0111	.0115	.0119	.0124
	3	4	.....	.....	.....	.....	.....	.0108	.0111	.0115	.0119	.0123	.0128	.0133
	4	6	.....	.....	.....	.....	.....	.0119	.0122	.0126	.0130	.0134	.0139	.0144

TABLE 155.—*Whitworth screw threads of special diameters, pitches, and lengths of engagement, pitch (effective) diameter tolerances, class 3 (close)*

Threads per inch	Lengths of engagement		Pitch diameter tolerances for diameters up to and including—											
	From—	To and including—	¼ inch	½ inch	¾ inch	1¼ inches	2 inches	3 inches	4 inches	6 inches	8 inches	11 inches	15 inches	20 inches
	Inches	*Inches*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
40, 36..	⅛	¼	0.0022	0.0024	0.0026	0.0028	0.0030	.....	.....	.....	.....	.....	.....	.....
	¼	⅜	.0024	.0026	.0028	.0030	.0032	.....	.....	.....	.....	.....	.....	.....
	⅜	½	.0026	.0028	.0030	.0032	.....	.....	.....	.....	.....	.....	.....	.....
32, 28..	⅛	¼	.0023	.0025	.0026	.0028	.0031	.....	.....	.....	.....	.....	.....	.....
	¼	⅜	.0025	.0027	.0029	.0031	.0033	.....	.....	.....	.....	.....	.....	.....
	⅜	½	.0027	.0029	.0031	.0033	.0035	.....	.....	.....	.....	.....	.....	.....
	½	¾	.0030	.0032	.0034	.0035	.....	.....	.....	.....	.....	.....	.....	.....
26, 24..	¼	⅜	.0026	.0028	.0029	.0031	.0034	0.0036	.....	.....	.....	.....	.....	.....
	⅜	½	.0028	.0030	.0031	.0033	.0036	.0038	.....	.....	.....	.....	.....	.....
	½	¾	.0030	.0032	.0034	.0036	.0038	.....	.....	.....	.....	.....	.....	.....
	¾	1	.....	.0035	.0037	.0039	.....	.....	.....	.....	.....	.....	.....	.....
20.....	¼	⅜	.....	.0028	.0030	.0032	.0034	.0037	.....	.....	.....	.....	.....	.....
	⅜	½	.....	.0030	.0032	.0034	.0036	.0039	.....	.....	.....	.....	.....	.....
	½	¾	.....	.0033	.0035	.0037	.0039	.0041	.....	.....	.....	.....	.....	.....
	¾	1	.....	.0036	.0038	.0039	.0042	.0044	.....	.....	.....	.....	.....	.....
18, 16..	¼	⅜	.....	.0029	.0031	.0033	.0035	.0038	0.0040	0.0042	.....	.....	.....	.....
	⅜	½	.....	.0031	.0033	.0035	.0037	.0040	.0042	.0044	.....	.....	.....	.....
	½	¾	.....	.0034	.0036	.0037	.0040	.0042	.0044	.0047	.....	.....	.....	.....
	¾	1	.....	.0037	.0038	.0040	.0043	.0045	.0047	.....	.....	.....	.....	.....
	1	1½	.....	.0040	.0042	.0044	.0046	.0049	.....	.....	.....	.....	.....	.....
14, 12..	⅜	½	.....	.....	.0034	.0036	.0039	.0041	.0043	.0046	.....	.....	.....	.....
	½	¾	.....	.....	.0037	.0039	.0041	.0044	.0046	.0048	.....	.....	.....	.....
	¾	1	.....	.....	.0040	.0042	.0044	.0046	.0049	.0051	.....	.....	.....	.....
	1	1½	.....	.....	.0043	.0045	.0048	.0050	.0052	.0055	.....	.....	.....	.....
	1½	2	.....	.....	.....	.0049	.0052	.0054	.0056	.0059	.....	.....	.....	.....
10.....	⅜	½	.....	.....	.....	.0037	.0039	.0042	.0044	.0047	0.0049	.....	.....	.....
	½	¾	.....	.....	.....	.0040	.0042	.0044	.0047	.0049	.0052	.....	.....	.....
	¾	1	.....	.....	.....	.0043	.0045	.0047	.0049	.0052	.0055	.....	.....	.....
	1	1½	.....	.....	.....	.0046	.0049	.0051	.0053	.0056	.0058	.....	.....	.....
	1½	2	.....	.....	.....	.0050	.0053	.0055	.0057	.0060	.0063	.....	.....	.....
8.....	½	¾	.....	.....	.....	.0041	.0043	.0046	.0048	.0050	.0053	0.0056	.....	.....
	¾	1	.....	.....	.....	.0044	.0046	.0049	.0051	.0053	.0056	.0059	.....	.....
	1	1½	.....	.....	.....	.0047	.0050	.0052	.0054	.0057	.0060	.0062	.....	.....
	1½	2	.....	.....	.....	.0052	.0054	.0056	.0059	.0061	.0064	.0066	.....	.....
	2	3	.....	.....	.....	.0057	.0059	.0062	.0064	.0066	.0069	.....	.....	.....
6.....	¾	1	.....	.....	.....	.....	.0048	.0050	.0053	.0055	.0058	.0061	0.0064	.....
	1	1½	.....	.....	.....	.....	.0052	.0054	.0056	.0059	.0061	.0064	.0067	.....
	1½	2	.....	.....	.....	.....	.0056	.0058	.0060	.0063	.0066	.0068	.0071	.....
	2	3	.....	.....	.....	.....	.0061	.0063	.0065	.0068	.0071	.0073	.0077	.....
	3	4	.....	.....	.....	.....	.0067	.0069	.0071	.0074	.0077	.0079	.....	.....
4.....	1	1½	.....	.....	.....	.....	.....	.0057	.0059	.0062	.0065	.0067	.0070	0.0074
	1½	2	.....	.....	.....	.....	.....	.0061	.0063	.0066	.0069	.0071	.0074	.0078
	2	3	.....	.....	.....	.....	.....	.0066	.0069	.0071	.0074	.0077	.0080	.0083
	3	4	.....	.....	.....	.....	.....	.0072	.0074	.0077	.0080	.0082	.0085	.0089
	4	6	.....	.....	.....	.....	.....	.0079	.0082	.0084	.0087	.0090	.0093	.0096

TABLE 156.—*Inspection gage data for screw threads of Truncated Whitworth form*

Gage dimensions	Information required: Detail	Information required: Found in table 157
SCREW		
PLAIN ADJUSTABLE SNAP GAGE:		*Column*
Major diameter "go" gage = maximum major diameter of screw.	Tolerance minus.....	13
Major diameter "not go" gage = minimum major diameter of screw.	Tolerance plus.....	13
"GO" THREAD RING GAGE:		
Major diameter.....	Cleared.....	3
Pitch (effective) diameter..	Set to check.	
Minor diameter—		
Maximum minor diameter of screw. (Check with plain check plug where dimension measured is less than ½ inch.)	Tolerance minus.....	12
Lead.....	Allowable variation, plus or minus.	7
Half angle.....	Tolerance, plus or minus.	8
THREAD CHECK FOR "GO" RING GAGE:		
Major diameter = maximum major diameter of screw.	Tolerance minus.....	12
Pitch (effective) diameter = maximum pitch (effective) diameter of screw.	Allowance minus.....	9
	Tolerance minus.....	10 or 11
Minor diameter.....	Cleared.....	5
Lead, allowable variation..	(Same as for gage checked.)	
Half angle, tolerance.....	(Same as for gage checked.)	
PLAIN CHECK FOR "GO" RING GAGE: (Used where dimension measured is less than ½ inch.)		
Limits.....	(Same as for minor diameter of gage checked.)	
"NOT GO" THREAD RING GAGE:		
Major diameter.....	Cleared.....	4
Pitch (effective) diameter..	Set to check.	
Minor diameter = minimum pitch (effective) diameter of screw minus $p/3$. (Check with plain check plug when dimension measured is less than ½ inch.)	Determine $p/3$ from..	6
	Tolerance plus.....	12
Lead.....	Allowable variation, plus or minus.	7
Half angle.....	Tolerance, plus or minus.	8
SCREW—Con.		
THREAD CHECK FOR "NOT GO" RING GAGE:		*Column*
Major diameter = maximum major diameter of screw.[1]	Tolerance plus.....	12
Pitch (effective) diameter = minimum pitch diameter of screw.	Tolerance plus.....	11
Minor diameter.....	Cleared.....	4
Lead, allowable variation..	(Same as gage checked.)	
Half angle, tolerance.....	(Same as gage checked.)	
PLAIN CHECK FOR "NOT GO" RING GAGE: (Used where dimension measured is less than ½ inch.)		
Diameter and limits.....	(Same as for minor diameter of gage checked.)	
NUT		
"GO" THREAD PLUG GAGE:		
Major diameter = minimum major diameter of nut.	Tolerance plus.....	12
Pitch (effective) diameter = minimum effective (pitch) diameter of nut.	Allowance plus.....	9
	Tolerance plus.....	10 or 11
Minor diameter.....	Cleared.....	3
Lead.....	Allowable variation, plus or minus.	7
Half angle.....	Tolerance, plus or minus.	8
"NOT GO" THREAD PLUG GAGE:		
Major diameter = maximum effective (pitch) diameter of nut plus $p/3$.	Determine $p/3$ from..	6
	Tolerance minus.....	12
Pitch (effective) diameter = maximum effective (pitch) diameter of nut.	Tolerance minus.....	11
Minor diameter.....	Cleared.....	4
Lead.....	Allowable variation, plus or minus.	7
Half angle.....	Tolerance, plus or minus.	8
"GO" PLAIN PLUG GAGE:		
Minor diameter = minimum minor diameter of nut.	Allowance plus.....	9
	Tolerance plus.....	14
"NOT GO" PLAIN PLUG GAGE:		
Minor diameter = maximum minor diameter of nut.	Tolerance minus.....	14

[1] Except that crest of thread shall never have a flat of less than 0.003 inch.

TABLE 157.—*Plain and thread inspection gages, screw threads of Truncated Whitworth form*

Threads per inch, n	Pitch, p	Root clearance width[1]			For diameter at crest of "not go" gage, apply value to pitch (effective) diameter, $\frac{p}{8}$	Lead, available variation[2]	Half-angle tolerance, all thread gages		Allowance[3]	Pitch (effective) diameter, tolerance		Major diameter thread plugs, and minor diameter thread rings, all classes; tolerance for "go" and "not go"	Plain gages, tolerances	
		"Go" thread plugs, rings, $0.2436p$	"Not go" thread plugs, rings, and checks, $\frac{p}{3}$	"Go" thread ring checks, $\frac{p}{8}$						Classes 1, 1½, and 2, "go" only	Class 3 "go", and classes 1, 1½, 2, and 3 "not go"		All classes of screws, major diameter, adjustable snap, "go" and "not go"	All classes of nuts minor diameter[4] to 3 in., inclusive, "go" and "not go"
1	2	3	4	5	6	7	8		9	10	11	12	13	14
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch* ±	*Deg.* ±	*Min.*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
40	0.02500	0.006	0.008	0.004	0.0083	0.0002	0	30	0.0001	0.0003	0.0002	0.0004	0.0002	0.00015
36	.02778	.007	.009	.005	.0093	.0002	0	30	.0001	.0003	.0002	.0004	.0002	.00015
32	.03125	.008	.010	.005	.0104	.0003	0	20	.0001	.0003	.0003	.0004	.0002	.00015
28	.03571	.009	.012	.006	.0119	.0003	0	20	.0002	.0003	.0003	.0005	.0002	.0002
26	.03846	.009	.013	.006	.0128	.0003	0	20	.0002	.0003	.0003	.0005	.0002	.0002
24	.04167	.010	.014	.007	.0139	.0003	0	20	.0002	.0003	.0003	.0005	.0002	.0002
22	.04545	.011	.015	.008	.0152	.0003	0	20	.0002	.0003	.0003	.0005	.0002	.0002
20	.05000	.012	.017	.008	.0167	.0003	0	20	.0002	.0003	.0003	.0005	.0002	.0002
18	.55556	.014	.019	.009	.0185	.0003	0	15	.0002	.0003	.0003	.0005	.0002	.0002
16	.06250	.015	.021	.010	.0208	.0003	0	15	.0002	.0004	.0003	.0006	.0002	.0002
14	.07143	.017	.024	.012	.0238	.0003	0	15	.0002	.0004	.0003	.0006	.0002	.0002
12	.08333	.020	.028	.014	.0278	.0003	0	10	.0002	.0004	.0003	.0006	.0003	.0003
11	.09091	.022	.030	.015	.0303	.0003	0	10	.0002	.0004	.0003	.0006	.0003	.0003
10	.10000	.024	.033	.017	.0333	.0003	0	10	.0002	.0004	.0003	.0006	.0003	.0003
9	.11111	.027	.037	.019	.0370	.0003	0	10	.0002	.0005	.0003	.0007	.0003	.0003
8	.12500	.030	.042	.021	.0417	.0004	0	5	.0002	.0005	.0004	.0007	.0004	.0003
7	.14286	.035	.048	.024	.0476	.0004	0	5	.0002	.0005	.0004	.0007	.0004	.0003
6	.16667	.041	.056	.028	.0556	.0004	0	5	.0003	.0005	.0004	.0008	.0005	.0004
5	.20000	.049	.067	.033	.0667	.0004	0	5	.0003	.0005	.0004	.0008	.0005	.0004
4½	.22222	.054	.074	.037	.0741	.0004	0	5	.0003	.0005	.0004	.0008	.0005	.0004
4	.25000	.061	.083	.042	.0833	.0004	0	5	.0003	.0006	.0004	.0009	.0005	.0004
3½	.28571	.070	.095	.048	.0952	.0004	0	5	.0003	.0006	.0004	.0009	.0005	.0004

[1] Root clearance may be sharp V, but in all cases must clear the crest of the thread being measured. See par. 7, p. 245.

[2] See par. 5, p. 245.

[3] This inspection gage allowance applies to favor wear to pitch diameter of classes 1, 1½ and 2, only, "go" thread gages and to "go" plain plugs of all classes for minor diameter of nuts. When work gages are used, this allowance shall be applied to favor wear for all classes.

[4] For diameters over 3 inches add 0.0001 for each additional 2 inches or fraction thereof.

TABLE 158.—*Suggested tap drill sizes,*[1] *screw threads of Truncated Whitworth form, coarse series*

Size	Minor diameter of nut		Stock drill	
	Minimum	Maximum	Designation	Decimal size
1	2	3	4	5
	Inches	*Inches*		*Inches*
1/8-40	0.0967	0.1020	No. 40	0.0980
			2.5 mm	.0984
			No. 39	.0995
3/16-24	.1403	.1474	No. 28	.1405
			9/64 in.	.1406
			3.6 mm	.1417
			No. 27	.1440
			3.7 mm	.1457
1/4-20	.1934	.2030	No. 10	.1935
			No. 9	.1960
			5 mm	.1968
			No. 8	.1990
			5.1 mm	.2008
			No. 7	.2010
5/16-18	.2495	.2594	1/4 in.	.2500
			6.4 mm	.2520
			6.5 mm	.2559
			F	.2570
3/8-16	.3042	.3145	7.75 mm	.3051
			7.8 mm	.3071
			7.9 mm	.3110
			5/16 in.	.3125
7/16-14	.3567	.3674	T	.3580
			9.1 mm	.3583
			23/64 in.	.3594
			9.2 mm	.3622
			9.25 mm	.3642
1/2-12	.4055	.4169	13/32 in.	.4062
			Z	.4130
			10.5 mm	.4134
9/16-12	.4680	.4794	15/32 in.	.4688
			12 mm	.4724
5/8-11	.5220	.5338	17/32 in.	.5312
			13.5 mm	.5315
1 1/16-11	.5845	.5963	15 mm	.5906
			19/32 in.	.5938
3/4-10	.6368	.6490	4 1/64 in.	.6406
7/8-9	.7492	.7620	3/4 in.	.7500
1-8	.8585	.8720	55/64 in.	.8594
			22 mm	.8661
1 1/8-7	.9631	.9776	24.5 mm	.9646
			31/32 in.	.9688
1 1/4-7	1.0981	1.1026	1 3/32 in.	1.0938
			28 mm	1.1024
1 1/2-6	1.3112	1.3269	1 5/16 in.	1.3125
			33.5 mm	1.3189
1 3/4-5	1.5234	1.5408	1 17/32 in.	1.5312
			39 mm	1.5354
2-4 1/2	1.7483	1.7668	1 3/4	1.7500
			44.5 mm	1.7520
			1 49/64	1.7656
2 1/4-4	1.9668	1.9868	50 mm	1.9685
			1 31/32 in.	1.9688
			1 63/64 in.	1.9844
2 1/2-4	2.2168	2.2368	2 7/32 in.	2.2188
			56.5 mm	2.2244
			2 15/64 in.	2.2344
2 3/4-3 1/2	2.4262	2.4481	2 7/16 in.	2.4375
			62 mm	2.4409
3-3 1/2	2.6762	2.6981	68 mm	2.6772
			2 11/16 in.	2.6875
			68.5 mm	2.6968

[1]This table is for reference only. It may be that, on account of unfavorable manufacturing conditions, the use of a drill given in this list will not result in the production of minor diameters lying within the specified maximum and minimum limits.

TABLE 159.—*Suggested tap drill sizes,*[1] *screw threads of Truncated Whitworth form, fine series*

Size	Minor diameter of nut		Stock drill	
	Minimum	Maximum	Designation	Decimal size
1	2	3	4	5
	Inches	*Inches*		*Inches*
3/16-32	0.1521	0.1577	No. 24	0.1520
			3.9 mm	.1535
			No. 23	.1540
			5/32 in	.1562
7/32-28	.1783	.1841	No. 15	.1800
			4.6 mm	.1811
			No. 14	.1820
1/4-26	.2065	.2125	5.25 mm	.2067
			5.3 mm	.2087
			No. 4	.2090
9/32-26	.2377	.2437	B	.2380
			6.1 mm	.2402
			C	.2420
5/16-22	.2610	.2684	G	.2610
			6.7 mm	.2638
			17/64 in	.2656
			6.75 mm	.2657
			H	.2660
3/8-20	.3184	.3280	8.1 mm	.3189
			8.2 mm	.3228
			P	.3230
			8.25 mm	.3248
7/16-18	.3745	.3844	9/32 in	.3750
			V	.3770
			9.6 mm	.3780
			9.7 mm	.3819
1/2-16	.4292	.4395	11 mm	.4331
			7/16 in	.4375
9/16-16	.4917	.5020	12.5 mm	.4921
			1/2 in	.5000
5/8-14	.5442	.5549	35/64 in	.5469
			14 mm	.5512
11/16-14	.6067	.6174	39/64 in	.6094
			15.5 mm	.6102
3/4-12	.6555	.6669	21/32 in	.6562
13/16-12	.7180	.7294	23/32 in	.7188
7/8-11	.7720	.7838	25/32 in	.7812
1-10	.8868	.8990	57/64 in	.8906
1 1/8-9	.9992	1.0120	1.0 in	1.0000
			25.5 mm	1.0039
1 1/4-9	1.1242	1.1370	1 1/8 in	1.1250
1 3/8-8	1.2335	1.2470	1 15/64 in	1.2344
			31.5 mm	1.2402
1 1/2-8	1.3585	1.3720	34.5 mm	1.3583
			1 23/64 in	1.3594

[1]This table is for reference only. It may be that, on account of unfavorable manufacturing conditions, the use of a drill given in this list will not result in the production of minor diameters lying within the specified maximum and minimum limits.

TABLE 160.—*Suggested tap drill sizes,*[1] *screw threads of Truncated Whitworth form British Standard pipe parallel, for general engineering purposes*

Size	Minor diameter of nut		Stock drill	
	Minimum	Maximum	Designation	Decimal size
1	2	3	4	5
	Inches	*Inches*		*Inches*
1/8-28	0.3425	0.3133	8.7 mm 11/32 8.75 mm 8.8 mm	0.3425 .3137 .3445 .3465
1/4-19	.4584	.4681	29/64	[2].4531
3/8-19	.5964	.6061	19/32	[2].5937
1/2-14	.7442	.7549	19 mm 3/4	.7480 .7500
5/8-14	.8212	.8319	21 mm 53/64	.8268 .8281
3/4-14	.9602	.9709	24.5 mm 31/32	.9640 .9687
7/8-14	1.1082	1.1189	1 7/64	1.1094
1-11	1.2060	1.2178	1 13/64	[2]1.2031
1 1/4-11	1.5470	1.5588	1 35/64 39.5 mm	[2]1.5469 1.5551
1 1/2-11	1.7790	1.7908	1 25/32	1.7812

[1]This table is for reference only. It may be that, on account of unfavorable manufacturing conditions, the use of a drill given in this list will not result in the production of minor diameters lying within the specified maximum and minimum limits.

[2]These drills are not within the minor diameter limits, but are the nearest smaller standard size. Provision should be made for machining to size.

APPENDIX 5. MISCELLANEOUS STANDARD THREAD PROFILES

1. GENERAL

For the convenience of users of this handbook, this appendix contains information regarding various thread profiles which find limited use in the United States, or which may be embodied in products entering into foreign trade. These threads are classified as translating threads, foreign standards for fastening screw threads, and buttress threads.

2. TRANSLATING THREADS[14]

In addition to Acme threads, there are other forms of thread used in industry for translating screws to meet special requirements. The designs included have been chosen with the dual purpose of meeting varied needs of users to the greatest possible extent, and at the same time establishing a product which can be economically produced. Changes in details are frequently incorporated to meet particular requirements. There is a considerable demand in mechanical industries for threaded assemblies which provide faster advance per revolution, and which give greater wear surface, for which it is recommended that a multiple thread[15] giving the desired lead be adopted. Many applications in the valve industry are typical.

(a). 29-DEGREE STUB THREADS

The angle between the sides of the thread is 29° as in the case of the Acme thread; the threads are truncated top and bottom, but the basic depth of thread is reduced to 0.30 of the pitch. The basic thread thickness is one-half the pitch as before, and the threads are symmetrical about a line perpendicular to the axis of the screw. This produces a very strong thread section, and in addition a thread admirably suited to applications where space limitations or other economic considerations make a shallow thread desirable. Basic dimensions of the 29 degree stub thread are given in table 161.

It is recommended that the basic diameters of the 29-degree stub threads be the same as for Acme threads, that is, the minimum pitch and minor diameters of the nut and the maximum major diameter of the screw should be basic.

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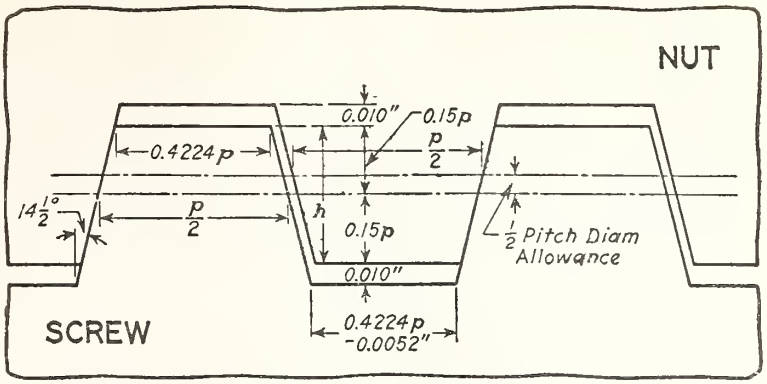
[14]These standards have been approved by the American Standards Association and published in ASA B1.3-1941-"Acme and Other Translating Threads" by the ASME, 29 West 39th St., New York 18, N.Y. (45c).

[15]Where it is necessary to use multiple threads, the form of single thread corresponding to "crests per inch" of the multiple thread should be used.

TABLE 161.—*Basic dimensions of 29 degree stub threads*



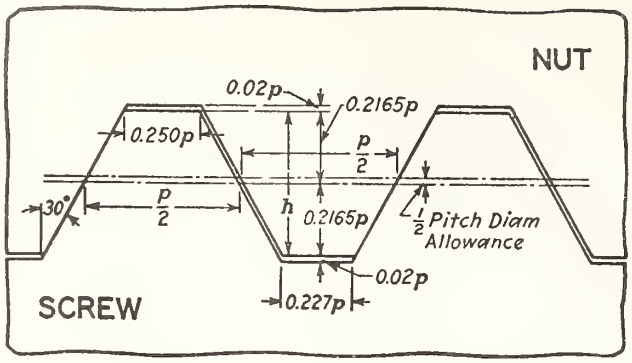
Threads per inch	Pitch, p	Depth of thread (basic), $h = 0.3p$	Total[1] depth of thread	Thread thickness (basic), $t = 0.5p$	Width of flat at	
					Crest of screw (basic), $F = 0.4224p$	Root of screw, $F_c = 0.4224p - (0.52 \times \text{clearance})$
1	2	3	4	5	6	7
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
16	0.06250	0.0188	0.0238	0.0313	0.0264	0.0238
14	.07143	.0214	.0264	.0357	.0302	.0276
12	.08333	.0250	.0300	.0417	.0352	.0326
10	.10000	.0300	.0400	.0500	.0422	.0370
9	.11111	.0333	.0433	.0556	.0469	.0417
8	.12500	.0375	.0475	.0625	.0528	.0476
7	.14286	.0429	.0529	.0714	.0603	.0551
6	.16667	.0500	.0600	.0833	.0704	.0652
5	.20000	.0600	.0700	.1000	.0845	.0793
4	.25000	.0750	.0850	.1250	.1056	.1004
3½	.28571	.0857	.0957	.1429	.1207	.1155
3	.33333	.1000	.1100	.1667	.1408	.1356
2½	.40000	.1200	.1300	.2000	.1690	.1638
2	.50000	.1500	.1600	.2500	.2112	.2060

[1] A clearance of at least 0.010 in. is added to "*h*" on threads of 10-pitch and coarser, and 0.005 in. on finer pitches, to produce extra depth, thus avoiding interference with threads of mating part at minor or major diameters. It is recognized that there are conditions where a greater or lesser clearance may be desirable.

(b) 60-DEGREE STUB THREADS

The angle between the sides of the thread is 60°. The threads are truncated top and bottom, have a basic depth of 0.433 of the pitch, a basic thickness of one-half the pitch, and are symmetrical about a line perpendicular to the axis of the screw. Basic dimensions of the 60 degree stub thread are given in table 162.

TABLE 162.—*Basic dimensions of 60-degree stub threads*



Threads per inch	Pitch, p	Depth of thread (basic), $h = 0.433p$	Total[1] depth of thread, $(h + 0.02p)$	Thread thickness (basic), $t = 0.5p$	Width of flat at	
					Crest of screw (basic), $F = 0.250p$	Root of screw $F_c = 0.227p$
1	2	3	4	5	6	7
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
16	0.06250	0.0271	0.0283	0.0313	0.0156	0.0142
14	.07143	.0309	.0324	.0357	.0179	.0162
12	.08333	.0361	.0378	.0417	.0208	.0189
10	.10000	.0433	.0453	.0500	.0250	.0227
9	.11111	.0481	.0503	.0556	.0278	.0252
8	.12500	.0541	.0566	.0625	.0313	.0284
7	.14286	.0619	.0647	.0714	.0357	.0324
6	.16667	.0722	.0755	.0833	.0417	.0378
5	.20000	.0866	.0906	.1000	.0500	.0454
4	.25000	.1083	.1133	.1250	.0625	.0567

[1]A clearance of at least $0.02p$ is added to "h" to produce extra depth, thus avoiding interference with threads of mating part at minor or major diameters.

(c) MODIFIED SQUARE THREADS

The angle between the sides of the thread is 10°. The threads are truncated top and bottom, have a basic depth of 0.50 of the pitch, a basic thread thickness of 0.50 of the pitch, and are symmetrical about a line perpendicular to the axis of the screw. The angle of 10 degrees results in a thread which is the equivalent of a "square thread" in so far as all practical considerations are concerned and yet capable of economical production. This thread form is illustrated in figure 50.

Multiple thread milling cutters and ground thread taps should not be specified for modified square threads of steep helix angle without consulting the cutting tool manufacturer.

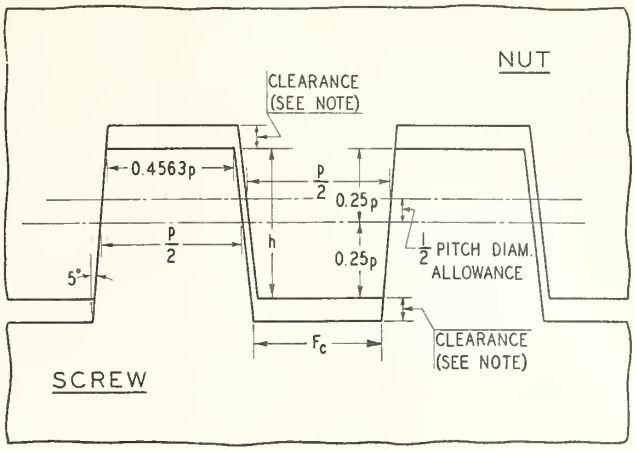


FIGURE 50.—*Modified square thread (10 degree included angle), basic proportions.*

p = pitch in inches
h (basic depth of thread) = $0.5p$
H (total depth of thread) = $0.5p$ + clearance
t (thickness of thread) = $0.5p$
F_c (flat at root of screw thread) = $0.4563p$ − (0.17 × clearance)
F (basic width of flat at crest of screw thread) = $0.4563p$

NOTE.—A clearance should be added to "h" to produce extra depth, thus avoiding interference with threads of mating parts at minor or major diameters. The amount of this clearance must be determined from the application of the thread assembly.

3. FASTENING SCREW THREADS, FOREIGN STANDARDS

Basic data relating to thread forms applied in important European screw thread systems are given below. Detailed data regarding standard diameters and pitches, tolerances, etc., may be obtained from the references cited.

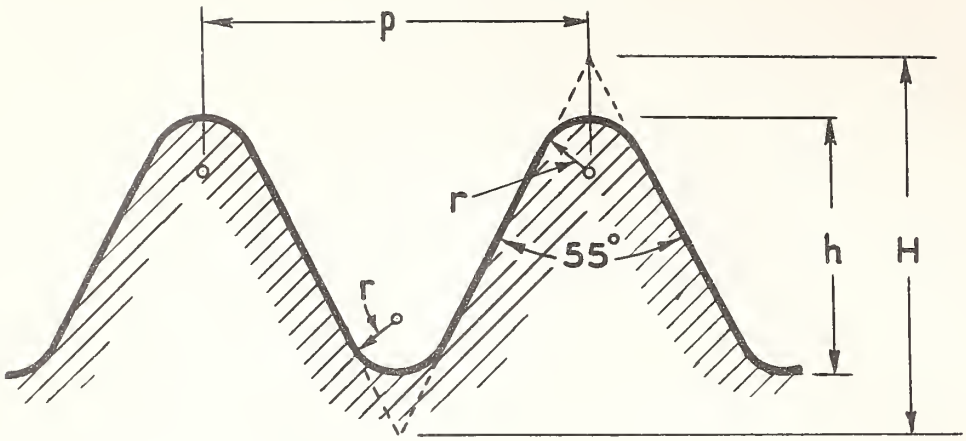
(a) BRITISH STANDARD WHITWORTH AND BRITISH STANDARD FINE SCREW THREADS[16]

The Whitworth series of screw threads was proposed in 1841 by Joseph Whitworth of Great Britain in a paper read before the Institution of Civil Engineers. The Whitworth thread angle, diameters, and pitches were chosen because they represented the average engineering practice at that time. Of thread angle, Mr. Whitworth said: "The mean of the angles in one inch screws was found to be about 55 deg, which was also nearly the mean in screws of different diameters, hence, it is adopted throughout the scale."

The British Standards Institution adopted the British Standard Whitworth screw threads (B.S.W.) in 1905 and issued a report giving the essential dimensions of the series. The thread angle in axial plane is 55 deg.; the threads are rounded equally at crest and root to a radius of $0.137329p$, and the resulting depth of thread becomes $0.640327p$. Thus, one-sixth of the depth of the basic triangle is removed from the crest of the thread, and one-sixth of the depth is filled in at the root. This form of thread is designated the "Whitworth" thread form, and is shown in Fig. 51.

The Whitworth form of thread is also used in the British Standard fine screw threads (B.S.F.) British Standard pipe threads (B.S.P.), and British Standard conduit threads.

[16] Institution of Civil Engineers, vol. 1, p. 157 (1841). British Standards Institution Standard No. 84-1940, "Screw threads of Whitworth form." (Add. June 1942, and April 1943.)



$$h = \frac{2}{3} H = 0.640327\, p$$
$$r = 0.137329\, p$$

FIGURE 51.—*Whitworth thread form.*

The British Standard fine screw threads were introduced in 1908 by the British Standards Institution, and are said to be well suited to the purposes for which they were designated.

Standards for the Whitworth thread series are issued by the Normenausschuss der Deutchen Industrie (Standards Committee of German Industry), with dimensions of the Whitworth series converted into the metric system.

(b) BRITISH ASSOCIATION SCREW THREADS[17]

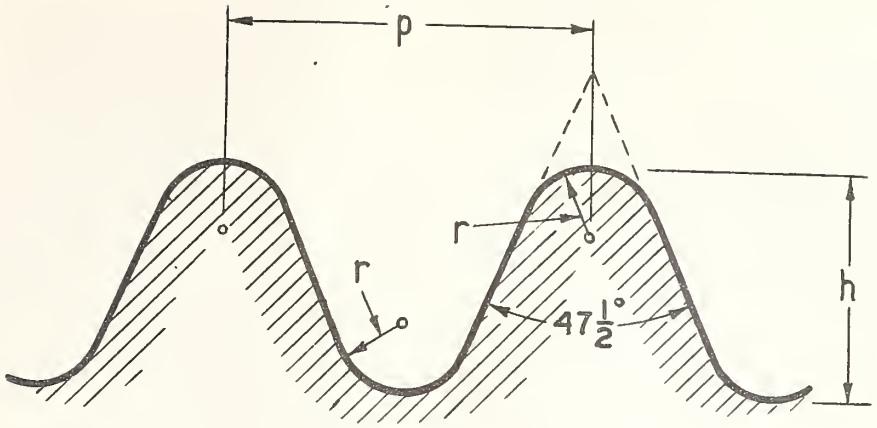
In 1878 the Horological Section of the Geneva Society of Arts recommended a system of screw threads designed by Prof. M. Thury. This system was based on the measurement of well proportioned watch and small instrument screws in actual use in European countries. This thread had an angle of 47.5 degrees and was rounded equally at crest and root to a radius of approximately two elevenths of the pitch. The sizes were designated by consecutive numbers, n, the pitch, p, corresponding to any given size being given by the formula:

$$p = 0.9^n,$$

and the major diameter, D, corresponding to any pitch, being given by the formula:

$$D = 6p^{6/5}.$$

[17] Systematique des Vis Horologeres, by M. Thury. Reports of the British Association for the Advancement of Science, 1884 and 1900. British Standards Institution Standard No. 93-1919.—British Association (B. A.) screw threads with tolerances for Nos. 0 to 15 B. A. (Add. August 1940.)



$$h = 0.600\,p$$

$$r = \frac{2}{11}p$$

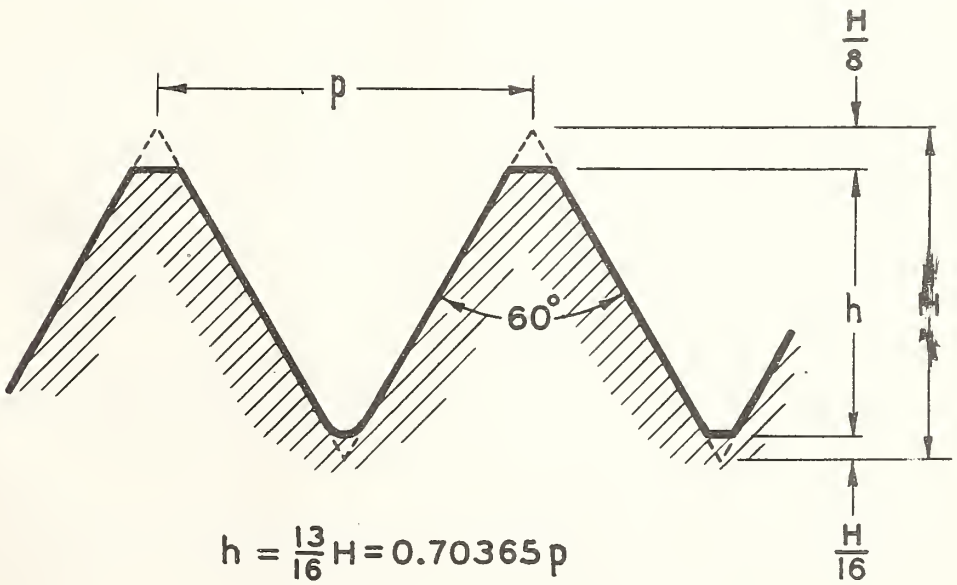
FIGURE 52.—*British Association thread form.*

In 1884 the British Association for the Advancement of Science recommended the use of the Thury system, with modifications, for all screws less than ¼ inch in diameter. The thread form was modified to give an equal rounding at crest and root of two-elevenths of the pitch. See figure 52. The British Standards Institution has adopted the British Association (B. A.) screw threads.

(c) INTERNATIONAL METRIC SCREW THREAD STANDARD[18]

The international screw thread standard (S. I.) was adopted by a congress, representing principal continental countries, at Zurich in 1898. The system proposed was based on the French metric screw thread system as adopted by the Société d'Encouragement de l'Industrie Nationale in 1894. The International form of thread has a 60° angle and the crest of thread is flattened one-eighth the height of the basic trangle while the root is filled in one-sixteenth the height, either flat or rounded, as shown in figure 53. This gives a definite clearance between the tops and bottoms of the threads of screw and nut. The actual form at the root is left to the choice of the manufacturer.

[18] Bulletin Soc. d'Encouragement pour l'Industrie Nationale, March 1899 and September-October 1919. Internationales Gewindesystem auf metrischer Grundlage, 1898, (Druck von F. Lohbauer, Zurich).



$$h = \frac{13}{16}H = 0.70365\,p$$

FIGURE 53.—*International metric form of threads.*

Sizes from 6 mm to 80 mm, inclusive, were standardized at the Congress of Zurich, and sizes above 80 mm were added by the Société de Encouragement pour l'Industrie Nationale of France. Also sizes were introduced between 12 mm and 40 mm, so that the series advances by 1-mm steps throughout this range.

A small machine screw series (Série de la Petite Mécanique) below the International series, from 2.5 to 5.5 mm, inclusive, was added by the Société d'Encouragement in 1906, and small watchmakers' screws (Série Horlogère), were standardized by the same body in 1909.

4. BUTTRESS THREADS

The buttress thread has certain advantages in applications involving exceptionally high stresses in one direction only, along the thread axis. As the thrust side of the thread is made very nearly perpendicular to the thread axis, the radial component of the thrust is reduced to a minimum and a solid bearing between the mating threads is produced. On account of the small radial thrust, this thread is particularly applicable when tubular members are threaded together. Examples of actual applications are the breech mechanisms of large guns and airplane propeller hubs.

Probably the earliest experimental work with this type of thread was done about 1888[19] with a thread having one side perpendicular to the thread axis and the other side making an angle of 45° to the perpendicular.

[19] "Screw Threads", John L. Gill, Jr. J. Franklin Inst. vol. 125, Mar. 1888, p. 185.

There is considerable variation in practice in the design of the buttress thread, but there are indications that the general adoption of a standard thread form would be advantageous. Inasmuch as a straight-sided and smooth thread cannot be cut at 90° to the thread axis, an angle of 7° between the leading or thrust side and a line perpendicular to the axis is recommended. As this angle is very nearly the static angle of friction of a well lubricated steel surface, the resultant radial stress on the nut is practically zero. Factors which govern the determination of the value of the nonthrust side angle are (1) The larger the angle, the greater the assymetry, and the greater the difficulty of producing a thread having accurate lead; (2) the smaller the angle for a given pitch and flat or radius at root the greater the depth of thread. An angle of 45° for the following or nonthrust side results in practical thread proportions, and is recommended. The included angle of the thread thus becomes 52°.

In order to minimize the concentration of stresses at the root of the thread of the screw, it is good practice to make the root of the thread rounded with a circular arc of as large a radius as practicable drawn tangent to the two sides of the thread.

A recommended standard basic thread form for buttress threads, which embodies the above recommendations, is shown in figure 54. Other features of this design are (1) A basic thread depth corresponding to a width of flat at crest and root of $\frac{1}{8} \times p$, with the maximum radius at the root of the screw tangent to the position of such flat, (2) a minimum width of flat at the minor diameter of the nut of $\frac{1}{4} \times p$, and (3) an allowance on diameter.

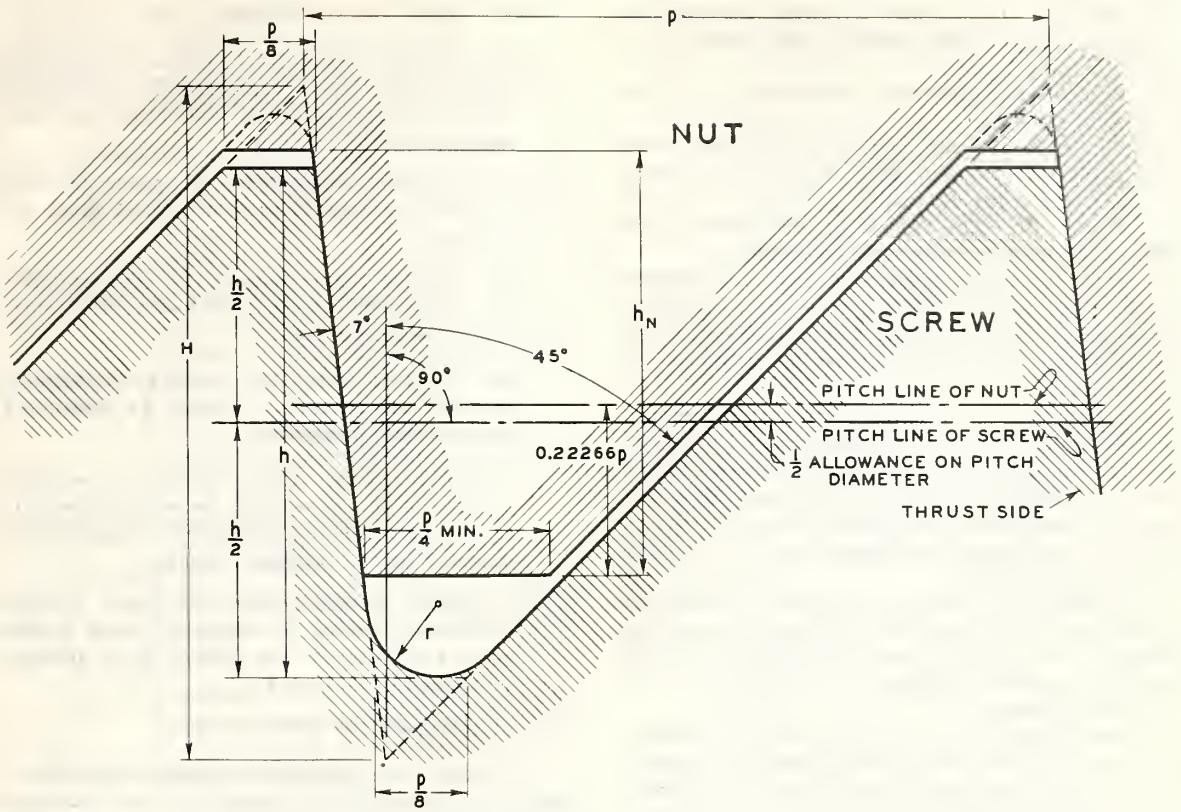


FIGURE 54.—*Recommended standard basic thread form for buttress threads.*

NOTATION

$H = 0.890643p$

$h \begin{cases} = 0.667982p \\ = \text{basic thread depth} \\ = \text{maximum depth of thread on screw} \end{cases}$

r (max) $= 0.0962p$ (tangent to $\frac{1}{8}p$ flat)

$h_N \begin{cases} = 0.556652p \\ = \text{maximum depth of thread in nut} \end{cases}$

NOTE.—Tolerances are not specified. Allowances on major and pitch diameters equal to $0.008\sqrt{D}$ are recommended.

APPENDIX 6. DEFINITIONS OF SYMBOLS DESIGNATING THE DIMENSIONS OF TAPER THREAD ELEMENTS

There are given in this appendix suggested symbols, which are intended to provide completely for designating the dimensions of thread elements of any taper screw threads. Some of the definitions given in section II are repeated here, with additional definitions.

Points on the surface of a taper thread may be located by reference to cylindrical coordinates.

Cross sections of thread profile are in planes containing the axis.

1. DEFINITIONS

1. *Screw thread.* [20]—A ridge of uniform section in the form of a helix on the surface of a cylinder or of a conical spiral[21] on the surface of a cone.

2. *External thread.*—An external thread is a thread on the outside of a member. Example: A threaded pipe.

3. *Internal thread.*—An internal thread is a thread on the inside of a member. Example: A threaded hole.

[20] In the following definitions the word "threads" is used to designate sections of a single screw thread cut by an axial plane and does not imply multiple threading.

[21] The curve of a taper screw thread is not a conical helix, which is a curve having a constant helix angle. The conical spiral is characterized by uniformity of pitch.

4. *Crest.*—The top surface joining the sides of a thread. On a taper thread, this surface is a part of the major cone.

5. *Sharp crest.*—The top intersection of the sides when extended.

6. *Root.*—The bottom surface joining the sides of adjacent threads. On a taper thread this surface is a part of the minor cone.

7. *Sharp root.*—The bottom intersection of the sides of adjacent threads when extended.

8. *Pitch cone.*—An imaginary cone, the surface of which would pass through the thread at such points as to make equal the widths between the sides of the thread and the spaces between the sides of adjacent threads.

9. *Major cone.*—An imaginary cone having an apex angle equal to that of the pitch cone, the surface of which would pass through such points, in the crest of an *external* thread or the root of an *internal* thread, which lie in the planes normal to the axis containing the "sharp crest" or "sharp root," respectively.

10. *Sharp major cone.*—An imaginary cone having an apex angle equal to that of the pitch cone, the surface of which would pass through the "sharp crest" of an *external* thread of the "sharp root" of an *internal* thread.

11. *Minor cone.*—An imaginary cone having an apex angle equal to that of the pitch cone, the surface of which would pass through such points, in the root of an *external* thread or the crest of an *internal* thread, which lie in the planes normal to the axis containing the "sharp root" or "sharp crest," respectively.

12. *Sharp minor cone.*—An imaginary cone having an apex angle equal to that of the pitch cone, the surface of which would pass through the "sharp root" of an *external* thread or the "sharp crest" of an *internal* thread.

13. *Vanish cone.*—An imaginary cone, the surface of which would pass through the imperfect roots of the threads formed by the lead or chamfer of the threading die.

14. *Side or flank.*—The surface which connects the crest with the root.

2. SUBSCRIPT DESIGNATIONS

(*a*) *Subscripts for reference planes.*—Numerical subscripts are used to designate certain planes at various positions on the thread axis, which are applicable to axial distances L, and to diameters D, E, and K corresponding to such distances. These refer to planes normal to the axis when the *external* and *internal* threads are assembled hand-tight without strain. In the definitions of symbols, the subscript x is used as a general designation of these numerical subscripts.

The x planes are as follows:

0 of reference, the plane in which the *external* taper thread has its least pitch diameter. Except in special cases, this plane coincides with the end of the pipe.

1 of hand-tight engagement, the plane in which the *internal* thread has its largest pitch diameter.

2 of effective thread length, the plane in which the minor cone of the *external* thread intersects the vanish cone.

3 the plane to which the least pitch diameter plane of the *external* thread is moved at wrench-tight engagement.

4 of vanish point. Vanish point is the intersection of an element of the vanish cone with an element of the cylinder of the largest major diameter of the *external* thread.

5 of perfect thread length, the plane in which the major cone of the *external* thread intersects a cylinder of the largest major diameter of the external thread.

x of any specified pitch diameter.

(*b*) *Subscripts for external or internal threads.*—When it is necessary to designate the exclusive application of a symbol to an external thread (or screw) the subscript S shall be used, and to an internal thread (nut or coupling) the subscript N shall be used.

3. SYMBOLS

A or A (alpha), angle of the thread. The angle included between the sides (flanks) of the thread.

a or α, half-angle of thread. The angle between the side (flank) of the thread and the perpendicular to the axis.

β (beta), apex angle of the pitch cone. This angle is generally expressed by the included taper—inches per foot. Included taper equals 24 tangent beta/2.

γ (gamma), angle of chamfer at the end of the pipe measured from a plane normal to the axis.

δ (delta), one half of the apex angle of the vanish cone on the *external* thread.

ϕ (phi), angle the leading thread side makes with the axis.[22]

θ (theta), angle the following thread side makes with the axis.[22]

p, pitch of the thread. The distance from a point on a thread to a corresponding point on the adjacent thread measured parallel to the axis. p (in inches) = 1/ number of threads per inch, = $1/n$.

Bp, the length from the "sharp crest" of an *external* thread to the "sharp root" following, measured parallel to the axis.

B, a function of angles β, θ, and ϕ, equals 0.49098 for American National pipe thread.

H, h, height or depth of thread.

H, the sharp height is the difference in radii of the *sharp major cone* and *sharp minor cone* measured in a plane normal to the axis.

h, h_S, the height of a truncated *external* thread is the difference in radii of the major cone and minor cone measured in a plane normal to the axis.

h_N, the height of a truncated *internal* thread is the difference in radii of the major cone and minor cone measured in a plane normal to the axis.

F_c, F_{cS}, width of the crest truncation of the *external* thread, measured parallel to the axis.

F_{cN}, width of the crest truncation of the *internal* thread, measured parallel to the axis.

F_r, F_{rS}, width of the root truncation of the *external* thread.

F_{rN}, width of the root truncation of the *internal* thread.

f_c, f_{cS}, height of the crest truncation of the *external* thread is the difference in radii of the *sharp major cone* and major cone measured in a plane normal to the axis.

f_{cN}, height of the crest truncation of the *internal* thread is the difference in radii of the *sharp minor cone* and minor cone measured in a plane normal to the axis.

f_r, f_{rS}, height of the root truncation of the *external* thread is the difference in radii of the sharp minor cone and minor cone measured in a plane normal to the axis.

f_{rN}, height of the root truncation of the *internal* thread is the difference in radii of the *sharp major cone* and major cone measured in a plane normal to the axis.

D_x, major diameter. The diameter of the major cone of *external* thread in plane x.

E_x, pitch diameter. The diameter of the pitch cone of *external* or *internal* thread in plane x.

K_x, minor diameter. The diameter of the minor cone of *external* thread in plane x.

D_{xN}, major diameter. The diameter of the major cone of *internal* thread in plane x.

K_{xN}, minor diameter. The diameter of the minor cone of *internal* thread in plane x.

L_x, length from reference plane 0 measured parallel to the axis.

D, outside diameter of the pipe.[23]

d, inside diameter of the pipe.[23]

t, wall thickness of the pipe.[23]

D_4, outside diameter of the pipe at the plane of vanish point, if different than D.

d_4, inside diameter of the pipe at the plane of vanish point, if different than d.

t_4, wall thickness of the pipe at plane of vanish point.

A, hand-tight standoff. The length at hand-tight engagement from the face of the coupling or internally threaded member to the plane of vanish point.

V, length of imperfect thread on vanish cone.

g, length from plane of pitch diameter E_5 to plane of vanish point.

τ (tau), angle the chamfer at the bottom of recess or counterbore in internally threaded member makes with the axis.

J, length from the centerline of coupling, face or flange, or bottom of an internal thread chamber, to the end of pipe made up wrench- or power-tight.

[22] The leading thread side of an *external* thread is the side nearest the reference plane 0. The leading thread side of an *internal* thread is the side which mates with the leading thread side of an *external* thread.

[23] For certain purposes the diameters of the portion of the pipe carrying the thread may be larger or smaller than D or d. the symbols resulting from the changed diameters are D_4, d_4, and t_4.

M, length from plane of hand-tight engagement to the face of coupling or internally threaded member.

$N_L/2$, length from the center of coupling, face of flange, or bottom of an internal thread chamber, to the end of coupling or face of hub.

Q, diameter of recess or counterbore in internally threaded member.

q, depth of recess or counterbore in internally threaded member.

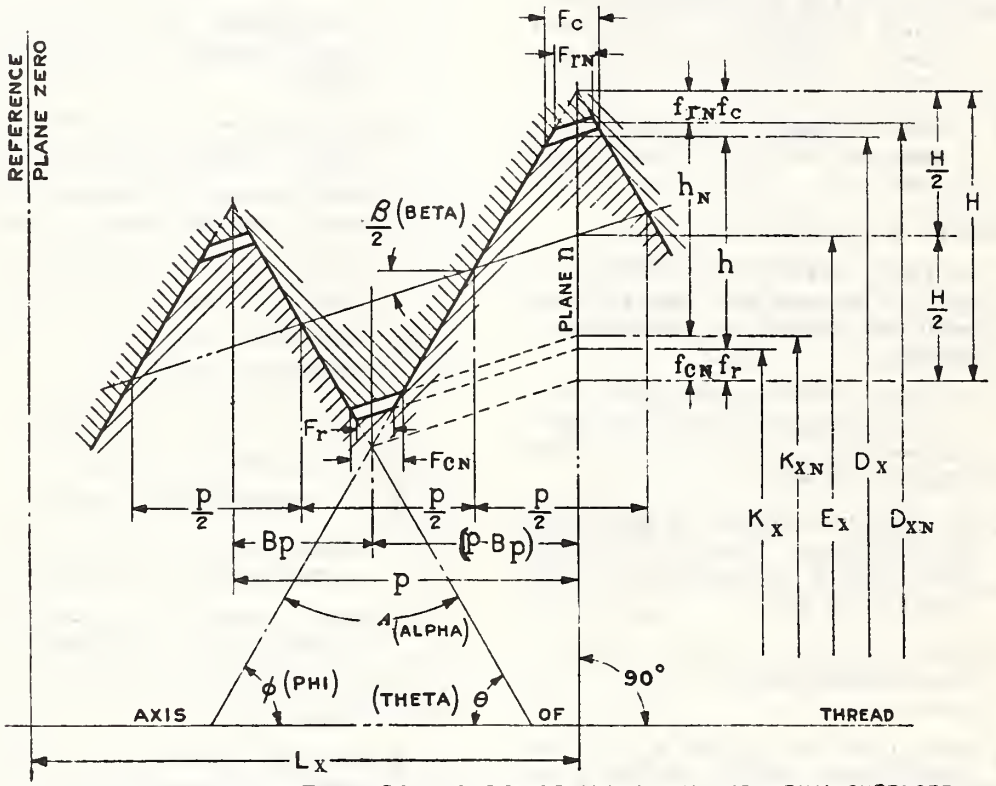
W, outside diameter of coupling or hub of internally threaded member.

S, distance gage notch on thread plug gage comes below face of fitting.

T, length of thread in fitting.

p', error in lead or pitch between any two threads.

a', α', error in half angle a or α (alpha).



NOTE.- THE CREST AND ROOT SURFACES ARE NOT NECESSARILY SURFACES OF THE MAJOR AND MINOR CONES.

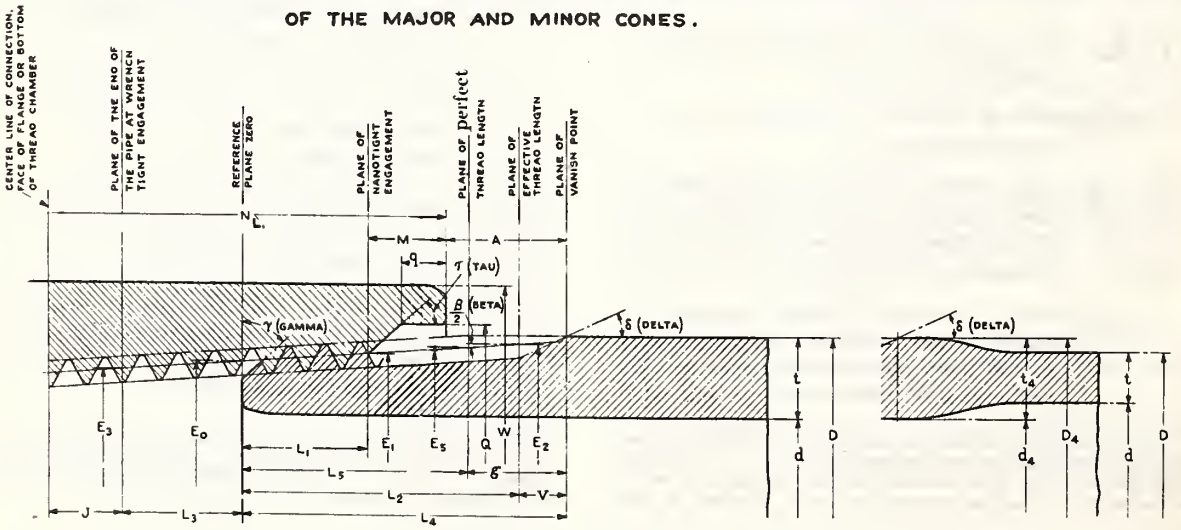


FIGURE 55.—*Schematic presentation of symbols for the dimensions of the elements of taper thread products.*

NOTE.—A particular product will use such part of the symbols as may be required for the purpose.

APPENDIX 7. COMMON PRACTICE AS TO THREAD SERIES AND CLASS OF FIT FOR SCREWS, BOLTS, AND NUTS

The usual commercial practice as to application of thread series and class of fit to screws, bolts, and nuts is indicated in table 163.

TABLE 163.—*Common practice as to thread series and class of fit for screws, bolts, and nuts*

Product	Thread series	Class of fit
1	2	3
Machine bolts	Coarse	Class 2.
Semifinished machine bolts	...do	Do.
Finished bolts	Coarse or fine	Class 3.
Machine screws	...do	Class 2.
Machine-screw nuts:		
Numbered sizes	...do	Class 1.
Fractional sizes	...do	Class 2.
Other standard nuts	...do	Do.
Cap screws	...do	Do.
Stove bolts	Coarse	Class 1.
Carriage bolts	...do	Class 2.
Step bolts	...do	Do.
Button-head bolts	...do	Do.
Set screws	...do	Class 3.[1]
Threaded studs:		
Nut end	...do	Class 2.
	Fine	Class 3.
Stud end	Coarse or fine	Class 5.
Tap bolts	Coarse	Class 2.
Tap rivets	...do	Do.

[1] See p. 202.

APPENDIX 8. ENDORSEMENTS

The Committee endorses the following specifications, which may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Commercial Standards of the U. S. Department of Commerce, National Bureau of Standards:
CS8-41. Gage Blanks (15c).
CS24-43. Screw Threads and Tap Drill Sizes (10c).
Simplified Practice Recommendations of the U. S. Department of Commerce, National Bureau of Standards:
R51. Chasers for Self-opening and Adjustable Die Heads (10c).
R169. Machine, Carriage, and Lag Bolts (Steel), (Stock Production Sizes) (5c).
Federal Specifications:
FF-B-561. Bolts, Lag; Steel (Lag-screws) (5c).
FF-S-111. Screws; Wood (5c).

The Committee also endorses the following standards, not included in this handbook, approved and promulgated by the American Standards Association, and issued by the ASME, 29 West 39th Street, New York 18, N. Y.

B 5.12-1940. Twist Drills, Straight Shank (55c).
B 5.4-1939. Taps, Cut and Ground Threads ($1.25).

The Committee further endorses the screw thread and screw-thread gage specifications included in the following American Petroleum Institute standards, which are issued by the American Petroleum Institute, Division of Production, Dallas, Texas.

No. 3. API Dimensional Standards for Cable Drilling Tools (75c).
No. 5-A. API Pipe Specification; Casing, Drill Pipe and Tubing (75c).
No. 5-B. API Inspection of Threads on Oil Country Tubular Goods (50c).
No. 5-F. API Tentative Specification for Threads in Valves, Fittings, and Flanges (65c).
No. 5-L. API Line Pipe Specification (75c).
No. 7-B. API Specifications for Rotary Drilling Equipment (75c).
No. 7-B-1. API Dimensional Information on External Upset, Internal Flush Drill Pipe and Internal-Flush Rotary Drilling Tool Joints.
No. 11-A. API Specifications for Cold Drawn and Machined Working Barrels (75c).
No. 11-B. API Sucker Rod Specifications (75c).

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